ELECTRICAL SOUTH

JULY
1943

FANS by HUNTER-CENTURY

55th SEASON

52-In Hotel Type

24-In "Airspread" Ceiling

HUNTER, who has made fans and ventilators exclusively during 55 years, is now operating under War Production Board restrictions. • No more fans will be made except for the Army, Navy and Maritime Commission. • HUNTER unfilled orders now on hand represent contracts with Government Agencies. • Certain sizes of belted exhaust types can be made available for Government hospitals and other war industries, subject to limited material inventories now on hand.

HUNTER FAN & VENTILATING COMPANY, INC.

Factory: FULTON, N. Y.

General Sales Offices: Memphis, Sterick Bldg. *Eastern Sales Office*: New York, 92 Warren Street *Western Sales Office*: St. Louis, 1706 Olive Street

Sales Offices:
ATLANTA
CHICAGO
DALLAS
HOUSTON
LOS ANGELES
PHILADELPHIA

Zephair Comfort Cooling and Commercial Ventilators

Sales Offices:
BOSTON
CLEVELAND
DETROIT
KANSAS CITY
NEW ORLEANS
PITTSBURGH

Cool light means efficient light

● There is a reason why cool fluorescent light is the most efficient practical light known. It's simply because a fluorescent lamp transforms electrical energy into more light and with less heat than other light sources.

For fluorescent light production involves an electro-chemical process rather than a heat process. That is, ultraviolet radiation of a precise wave length causes the fluorescent powder coating inside the tube to emit light, rather than heat energy in the form of invisible infrared radiation.

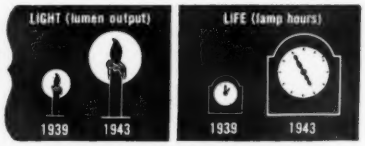
And there is a reason why Sylvania Fluorescent Lamps are as coolly efficient as modern research can make them. Sylvania engineers have drawn on years of specialized and basic experience with incandescent lamps, radio tubes, ultraviolet lamps and other electronic devices. Their aggressive and independent research has helped to make fluorescent a "must" for precision war production, and the best lighting for your home when Victory is won.

Sylvania's tireless research makes continued and consistent improvement possible. For more output, longer life and uniform color – specify Sylvania Fluorescent Lamps in authorized new installations and replacements.

SELL SYLVANIA AND GIVE YOUR CUSTOMERS FAR MORE LIGHT AND LIFE FOR THEIR MONEY

Compared with 1939 a dollar invested today in Sylvania Fluorescent Lamps buys more than four times the lumen output and approximately five times the lamp life.

SYLVANIA FLUORESCENT DOLLAR BUYS:



(Based on decreasing price and increasing efficiency and durability of Sylvania 40-Watt White Fluorescent Lamp)

SYLVANIA

ELECTRIC PRODUCTS INC.

Formerly Hygrade Sylvania Corporation

Salem, Mass.

INCANDESCENT LAMPS, FLUORESCENT LAMPS, FIXTURES AND ACCESSORIES, RADIO TUBES, ELECTRONIC DEVICES.

ELECTRICAL SOUTH is published monthly by W. R. C. Smith Publishing Co., Marietta, Ga., and Atlanta, Ga., U. S. A. Subscription rates, United States and Possessions, $1.00 for one year; Canada, $1.50 per year; Foreign Countries, $2.00 per year. Entered as second class matter at the postoffice, Marietta, Ga., under Act of March 3, 1879.

Volume 23 Number 7

Here's what you get Today in PANTHER and DRAGON Tapes!

FRICTION TAPE

1. Guaranteed Footage
2. Substantial Fabric
3. High Tensile Strength
4. High Dielectric Strength
5. High Adhesive Strength
6. Uniform Thickness
7. Uniform Width
8. Excellent Tackiness
9. Strong, Durable Core
10. Colorful, Attractive Boxes

RUBBER TAPE

1. Guaranteed Footage
2. High Grade Compound
3. High Tensile Strength
4. High Elongation
5. High Dielectric Strength
6. Uniformity of Thickness and Width
7. Excellent Fusion
8. High Insulation Resistance
9. Excellent Tackiness
10. Colorful, Attractive Boxes

PANTHER and DRAGON Friction and Rubber Tapes comply liberally with all the requirements of Federal Emergency Specifications as well as those of A.S.T.M.

Sixty-five years of manufacturing wire and cable insulation as well as tapes has taught us how to make long-lived tapes that will provide firmly adhering, weather-resisting mechanical splices for insulated wires and cables.

You make no mistake when you specify and use PANTHER and DRAGON Tapes as so many electrical contractors throughout the country are doing.

Rubber tapes are available in both PANTHER and DRAGON Brands.

3291

Sold Through Recognized Independent Wholesalers. • • • •

PANTHER & DRAGON
FRICTION AND RUBBER TAPES

HAZARD INSULATED WIRE WORKS — DIVISION OF THE OKONITE CO.

WILKES-BARRE, PENNSYLVANIA • OFFICES IN PRINCIPAL CITIES

GREAT NAMES in American Progress

ROBERT FULTON, BOAT BUILDER — On a fateful Friday in 1807, a skeptical crowd gathered at the foot of Cortlandt Street, New York. They came to watch "Fulton's Folly" attempt the "impossible" by traveling without sails from New York to Albany. Those who came to jeer stayed to cheer. "Crazy" Bob's puffing, snorting Clermont wheezed away from the jetty and grunted upstream against the wind at the miraculous speed of four miles an hour. On that day, Robert Fulton, well-nigh penniless dreamer, revolutionized the water-borne transportation of the world.

AMERICAN BLOWER

American Blower products have contributed much towards the progress of American industry — progress that today is making it possible for America's vital industries to outproduce the world. In the great public utilities, the steel industry, in the manufacture of petroleum products, chemicals, in food processing, mining, smelting and refining, in hospitals, schools, public buildings and homes, American Blower air handling equipment has kept pace with progress.

CONTRACTORS—DEALERS— We're working 100% for victory. But you can still buy American Blower products for vital war work. After victory we'll be ready with the most complete line of heating, ventilating and air handling equipment in history.

ARMY E NAVY
For excellence in production

AMERICAN BLOWER CORPORATION, DETROIT, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator and Standard Sanitary Corporation

Utility Set

What's behind the TRADE MARK?

BEHIND the trade mark of The Youngstown Sheet and Tube Company is an interesting story. Founded in 1900, its career is a typical American achievement, representing 43 years of steady, substantial growth. As the original plans of its founders have gradually unfolded, Youngstown has been permitted to make material contributions to the welfare of the nation.

Integrity of purpose, courage, ability, a spirit of venture, the will to serve its customers—these are some of the things that give life and substance to the Youngstown trade mark. They have built the company from its small beginning with only a few thousand tons capacity to a position among the leaders in 1943—with an annual capacity of 4,000,000 tons of steel.

We here at Youngstown are devoting our energies 100% to meeting the emergencies of war now as we did in World War I. When peace comes, we shall devote all our resources to the requirements of our thousands of customers old and new.

The YOUNGSTOWN
SHEET AND TUBE COMPANY, *Youngstown, Ohio*
Manufacturers of
CARBON · ALLOY AND YOLOY STEELS

Pipe and Tubular Products • Sheets
Plates • Conduit • Bars • Tin Plate
Rods • Wire • Nails • Tie Plates and
Spikes • Alloy and Yoloy Steels

25-47F

Suppose they hadn't been on the air for 343 weeks . . .

Suppose the girls of the G-E MAZDA Lamp Hour of Charm weren't today reaching an audience of 16,000,000 people a month . . .

Suppose they *hadn't* delivered over 500 lighting messages in the past six and a half years that the program has been nationally broadcast.

Do you suppose there would be the same appreciation of the benefits of good lighting as there is today?

Do you suppose that at the end of the war there would be as big a potential market for new lighting among those millions of listeners?

The G-E Hour of Charm is the only nation-wide lighting program on the air. Every Sunday, 10 P.M., EWT, over 125 NBC stations. See how it tells the benefits of light for production—just as it told America about better light for better sight before the war—and will again after the war. Listen also to "The World Today" weekdays 6:45 P.M., EWT, CBS.

G-E MAZDA LAMPS

GENERAL ELECTRIC
HOUR OF CHARM
Opening Announcement

A typical Hour of Charm announcement on light for production

ANNOUNCER

Here is a very significant message from the production manager of a middle western war plant. His factory makes artillery shells. A job calling for high speed -- and high precision. Listen to what he says.

VOICE

Our shell factory was going great guns in the daytime, but lagging badly on the night shifts. Night production was 40 per cent behind daytime production. And that condition -- across the country -- could be deadly serious.

Well -- we licked that problem -- with the help of a lighting engineer. He surveyed our plant and made some commonsense recommendations which we carried out. Today we are producing at top speed right around the clock. As a production man who has been through this experience, I strongly recommend that every war factory look into its lighting.

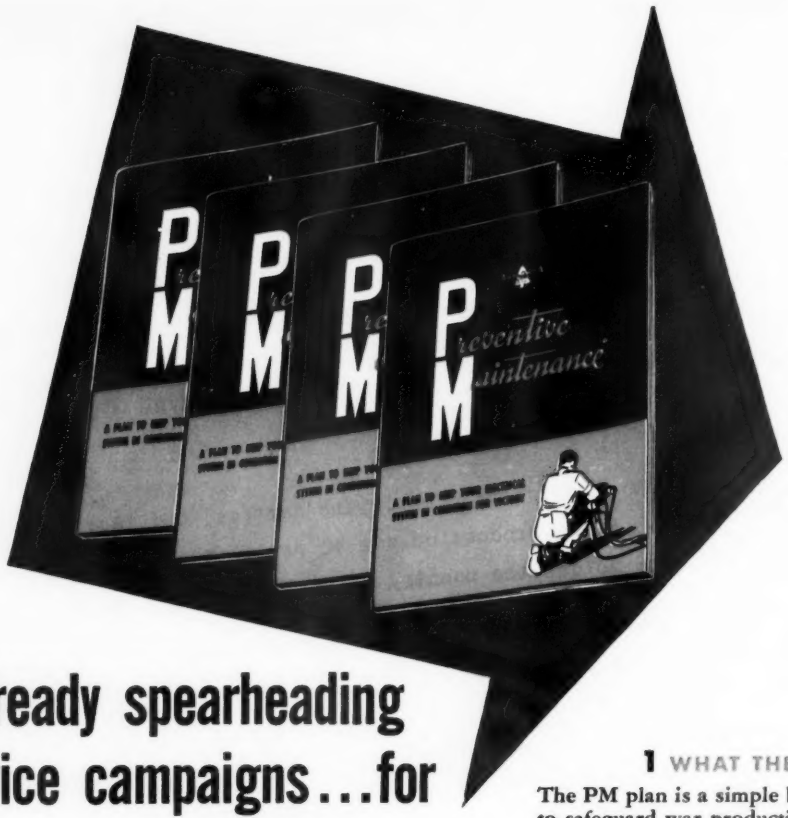
ANNOUNCER

Thank you. Friends -- if you are responsible for any sort of war production, won't you at least have your lighting checked up? It may make a big difference, especially in your night production. All you need to do is phone your nearest G-E MAZDA lamp office or your Electric Service Company, Electrical Jobber or Contractor. A wartime lighting ~~man~~ counsellor will call, check your lighting, and tell you how to correct what is wrong. There is no charge, and no obligation. All you have to do is make that phone call.

Here is Dick Stark, announcer on the Hour of Charm, reading a lighting message as Evelyn, First Lady of the Orchestra, waits her cue to play.

The best Investment in the World is in this Country's Future—Buy War Bonds!

GENERAL ELECTRIC



Already spearheading service campaigns...for more than 40 Utilities

THE PM PLAN

Introduced a short time ago, Anaconda's Preventive Maintenance Plan is being widely used by utilities to help customers keep electrical systems operating *efficiently*—despite shortages in essential wiring equipment.

Already some 40 utilities are actively engaged in this program. With it, they are helping their industrial power customers maintain continuous wartime production by preventing electrical breakdowns.

1 WHAT THE PLAN IS

The PM plan is a simple but comprehensive way to safeguard war production by preventing electrical breakdowns *before they develop.*

2 HOW IT WORKS

The plan provides a practical means of making periodic, systematic analysis of circuits and equipment. Uncovers potential weaknesses . . . suggests ways to correct them . . . prevents overloading of lines.

Data thus gathered aids local W.P.B. Branches in reaching decisions on requests for materials to *prevent* breakdowns.

3 HOW UTILITIES BENEFIT

The PM plan helps utilities maintain close customer contact despite a lack of "something to sell." Offers basis for service campaign that definitely appeals to customers. Puts the utility in a leadership role for furthering war production throughout the area it serves.

If you aren't already utilizing the Anaconda Preventive Maintenance Plan, mail the coupon for full details. 43254

"Tomorrow may be too late . . . do it today!"

ANACONDA'S PREVENTIVE MAINTENANCE PLAN

ANACONDA

Anaconda Wire & Cable Company
25 Broadway, New York City

Please send copy of the Anaconda Preventive Maintenance Plan for safeguarding wartime production.

Individual .....

Company .....

Address ..... City .....

7H

JULY, 1943

Volume 23 No. 7

ELECTRICAL SOUTH

J. C. MARTIN,
Manager

W. E. COOGLER,
Production Manager

Editorial and Business Offices
GRANT BUILDING
ATLANTA, GEORGIA

Member of A. B. P.
Member of A. B. C.

ANNUAL SUBSCRIPTION—$1.00
THREE YEARS—$2.00
CANADA—$1.50 FOREIGN—$2.00

Business Representatives:
L. E. ALLEN, 189 West Madison St., Chicago, Ill. Tel.: Lakeview 10282.
L. R. MCCARTY, 325 Winding Way, Merion, Pa. Tel.: Merion 1066.
W. A. MCGEE, P. O. Box 562, Charlotte, N. C. Tel.: 3-4932.

Published Monthly by
W. R. C. SMITH PUBLISHING CO.
Marietta and Atlanta, Ga.

W. J. ROOKE, *President*
T. W. MCALLISTER, *Vice-President and Editorial Director,*
E. W. O'BRIEN, *Vice-President,*
R. W. PHILIP, *Vice-President,*
RICHARD P. SMITH, *Vice-President,*
O. A. SHARPLESS, *Treasurer,*
J. C. MARTIN, *Secretary.*

Publishers Also of
COTTON
SOUTHERN HARDWARE
SOUTHERN AUTOMOTIVE JOURNAL
SOUTHERN POWER AND INDUST...

T. W. McALLISTER, Editorial Director CARL W. EVANS, Editor
NAT M. JOHNSON, Southwestern Editor

Contents

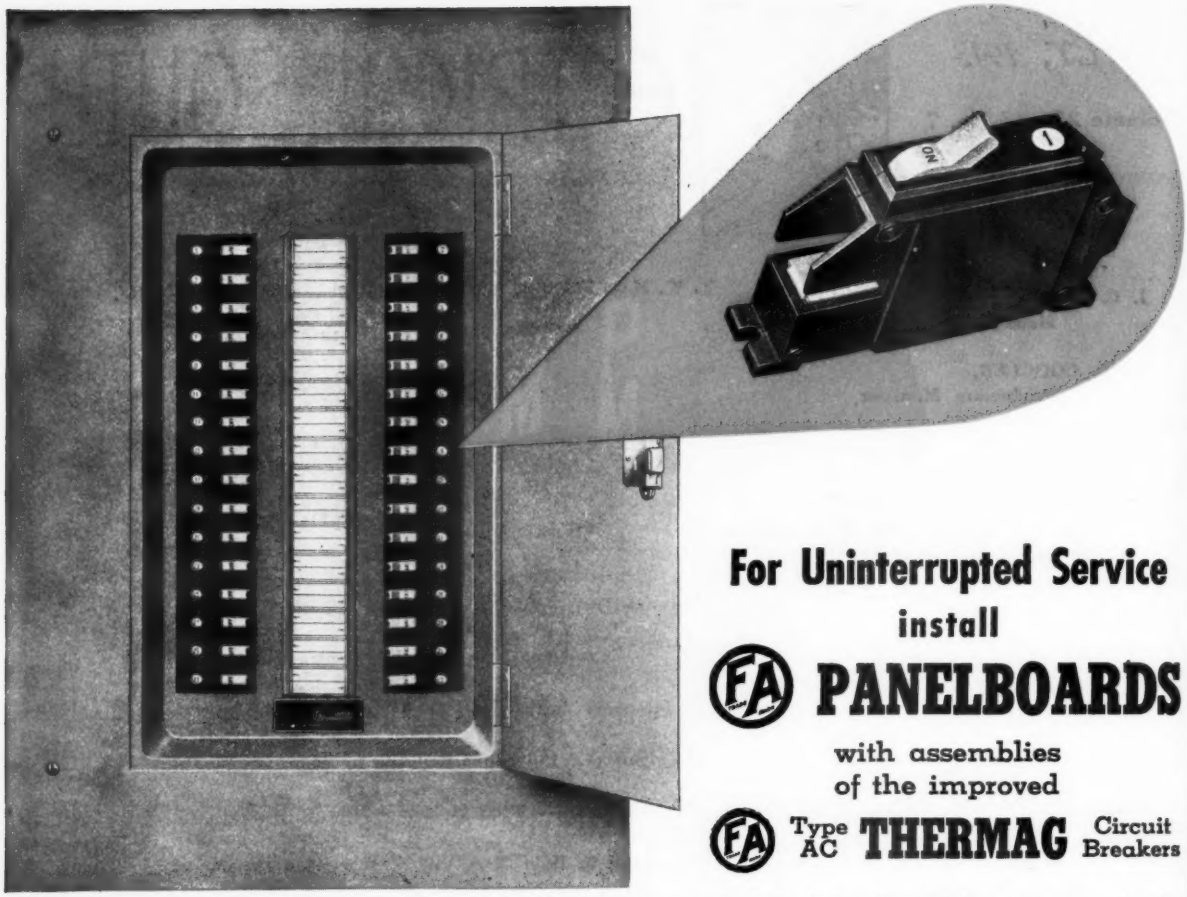
Network Distribution for Industrial Plants	9
Service Firm Keeps Busy on War Contracts	12
Maintenance Instructions for Fractional Hp Motors	13
Accidents and Rejections Reduced by Improved Lighting	15
The Amplidyne—What It Is and How It Works	16
Inspectors to Hold War Conference in New Orleans	19
Electrical Maintenance in a Bakery	20
Burnishing Tool for Small Motor Commutators	22
Reconnecting Three-Phase Motors for New Conditions	23
Servicing the Refrigerator—Part 5, Expansion Valves	26

Departments

Government Regulations Affecting the Industry	31
News of the Electrical Industry	32
Personal Notes About Men You Know	42
New Electrical Equipment and Materials	46

Copyrighted 1943, W. R. C. Smith Publishing Co., Atlanta, Ga.

Entered as second class matter at Marietta, Ga., U. S. A., under Act of March 3, 1879.



For Uninterrupted Service install FA PANELBOARDS

with assemblies of the improved FA Type AC THERMAG Circuit Breakers

The Safety Panelboard above is Catalog No. FA NAC1B32-3L20. It contains 32 FA Type AC Thermag Circuit Breakers, and 200 ampere 3 wire main connection. An enlarged view of the individual Circuit Breaker is shown at the right.

They not only provide full protection against short circuits and dangerous overloads, *but prevent unnecessary interruptions in service* due to momentary or slight overloads.

The combination of the time-tried THERmal trip with the new MAGnetic trip, in the individual circuit breakers, assures this double protection. On harmless, momentary overload the time lag characteristics of the thermal element prevent interruption of service, but trip on sustained, harmful overload. On short circuit, the magnetic element causes *faster* tripping.

When tripped, the handle of the single pole breaker automatically returns to the OFF position, thus indicating the circuit affected. On the double pole breaker, a red signal button is protruded from the face of the breaker on which the trouble has occurred.

Write for BULLETIN 69

Especially prepared for the use of Architects, Engineers and Contractors, it contains a mine of useable information on panelboards and cabinets. It is a real aid in planning and engineering electric distribution installations for light, heat and power. Write for your copy . . . Frank Adam Electric Co., St. Louis, Mo.

FA PANELBOARDS—THERMAG EQUIPPED

are made in Standard Type, Narrow Column Type, and Dust-tight Type construction. They are available with from 4 to 42 circuits, for either flush or surface mounting . . . Capacities: 50 amperes or less, 120 volts AC, single or double pole, individual trip . . . Approved by Underwriters' Laboratories, Inc.

Installation and connection are facilitated by new and improved FA Pressure Connectors. Ample knockouts are provided in the steel boxes. Fronts are bonderited, to prevent rusting, and finished in pearl gray lacquer.

EST. 1891 THE SIGN OF A BETTER JOB

Frank Adam

ELECTRICAL PRODUCTS for War Industry

FRANK ADAM ELECTRIC CO. ST. LOUIS, MO. U.S.A.

Industrial Network Distribution Advantages and Disadvantages

By D. L. Beeman*

DURING recent years, particularly within the last year and a half of the industrial expansion, there has been an increasing number of low-voltage (600 volts and below) alternating-current secondary network systems employed in industrial plants. This system was originally developed by central station utilities for distributing electric power in the downtown or commercial areas of large cities. When electrical systems and equipment specifically developed for a given purpose in one field are being adapted for use in another field, it is logical to review thoroughly the requirements of the new field to determine wherein the requirements differ. Many papers have been written which provide a complete history on various phases of this system. (1)**

As basic a-c sources became more reliable, there was a desire on the part of many engineers to use a-c distribution systems in the downtown areas of large cities, for the following reasons:

1. Alternating-current distribution systems do not require rotating converting machinery, but instead use simple transformers.
2. A-c power can be distributed at high voltage, thereby reducing the number of substations in the congested area, thus making unnecessary the purchase of high-cost real estate.
3. A substantial reduction feeder copper investment can be made.

As a result of these advantages, developments were started on the a-c network system more than twenty years ago and the first installation designed along modern lines was made in the early 1920's. To date, installations have been made by utilities in more than 160 cities.

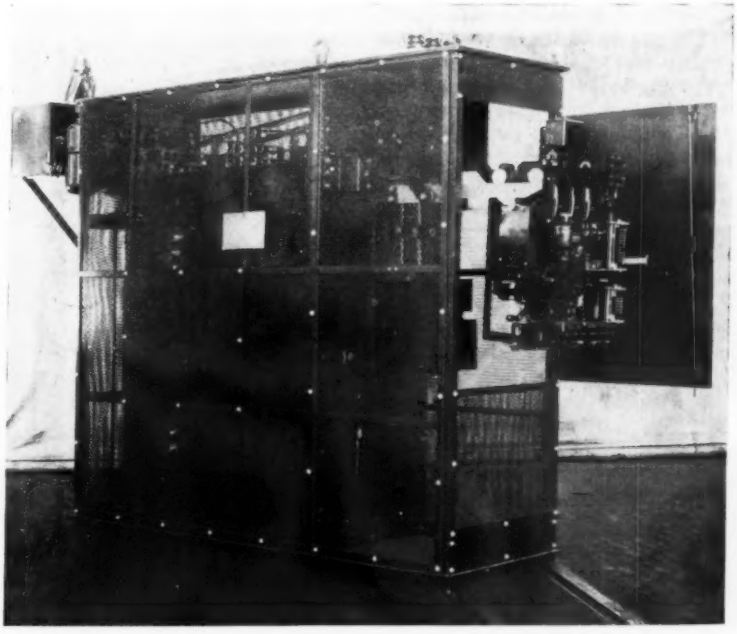
The sole reason for using secondary networks instead of radial distribution systems in these cities is to provide a high order of service reliability. Even to approach, with a radial system, the required service reliability would cost far more than the type of a-c secondary network used by the utilities. While the factors of service reliability and economics result in the network being favored over the radial system for the downtown section of a city, these factors do not necessarily result in the same conclusions in the industrial field where other items are also pertinent, such as system operation and maintenance, and characteristics of loads.

Service Reliability

There are many factors which determine the service reliability required from and delivered by an electrical distribution system. To make their product—electric service—attractive to the public, utilities have set very high service reliability standards. These standards may often be too high from the standpoint of economics[2], but once they are set there is no retreating from them. Hence when an a-c distribution system was developed for the downtown areas of large cities, this system had to provide as high an order of service reliability as its predecessor. This meant that an a-c secondary network and not an a-c radial system was required to supplant the d-c network system.

Utility distribution systems in downtown areas are almost universally underground. Hence cables, transformers, and other equipment are subject to extreme dampness and to flooding which cause about 50 to 90 per cent of the equipment failures. Cable lines in public streets are often dug into, causing numerous cable faults.

Coupled with these difficulties are the extreme lengths of primary feeder cables and the large number of transformers per primary feeder. It is not uncommon to have primary feeders with 10 miles of



A new three-phase dry-type network transformer especially designed for industrial electrical distribution systems. This is a view of high-voltage side, showing network protector unit drawn out.

*Mr. Beeman is associated with General Electric Co. in the Industrial Engineering Dept.
**Numbered references are listed at the end of this article.

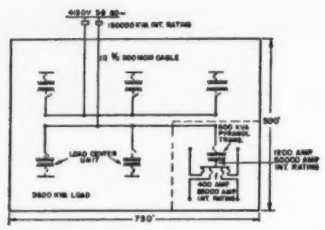


Fig. 1. Schematic circuit diagram of a typical industrial power distribution system.

cable and 50 transformers per feeder.

Operating records[3] show that in underground distribution systems there is one failure per 10 miles of cable per year and there is one failure per year per 200 transformers. Hence, an underground feeder with 10 miles of cable and 50 transformers would be out of service due to failure of apparatus on an average of 1-1/4 times a year.

Utility systems are continually changing and expanding which requires frequent deenergization of primary feeder circuits for connecting in new equipment. Load cannot be dropped while these changes are being made.

With the above factors present, continuous service depends on providing duplicate supplies for carrying the load during outages on one portion of the system. Every time a radial system feeder was deenergized there would be a service outage of up to 24-hours in duration. "Modified radial systems", discussed later under that heading, have been used in some cases to prevent these long outages, but because of economics and operating restrictions have never been widely used in the downtown areas of large cities.

Industrial Plant Needs

In contrast, the service reliability required of an industrial plant distribution system can be determined by the plant owner. He can evaluate the probable outage time of the various electrical circuit arrangements as a function of their cost and select the one that best suits his requirements. He alone is affected by his decision.

Primary feeders are short, usually less than half a mile long. If the same cable failure rate applied as to utilities, the probability of a failure in this half mile long cable would be one in 20 years instead of one per year with the 10-mile long utility feeder. The primary feeders in the usual industrial system may be in dry locations and not subject to flooding or extreme moisture conditions. Hence, the average cable failure rate may be one per mile of cable per 20 to 50 years in industrial plants or 1/2 to 1/5 that for utility systems. If such performance can be obtained, little if any money or material can be justified to provide duplicate cable circuits to improve service reliability.

The very few transformers (3 or 4) per primary feeder are almost universally located in dry locations within the industrial plant buildings. This lowers the transformer failure rate to about one per year per 2000 transformers. On the basis of this probability rate, a factory having six transformers in the distribution system, Fig. 1, theoretically could expect one transformer failure about every 330 years—a performance so good that little if any additional money or material can be justified to provide continuous service in the event of a transformer failure. As a matter of record, there are hundreds of industrial plants which have been operating 20 to 30 years without a shutdown due to transformer failures.

Changes in the electric system of an industrial plant can be made when the factory is shut down for production line changes or over

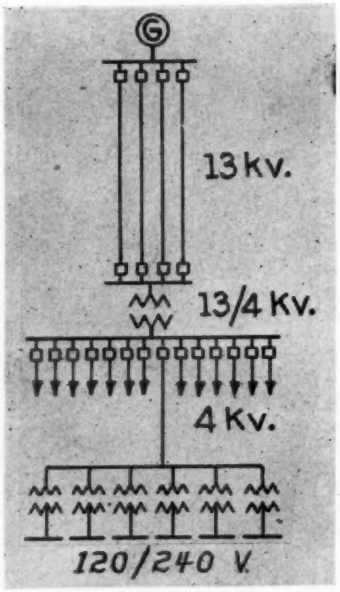


Fig. 2. Circuit diagram of a radial distribution system with double transformation as used by utilities.

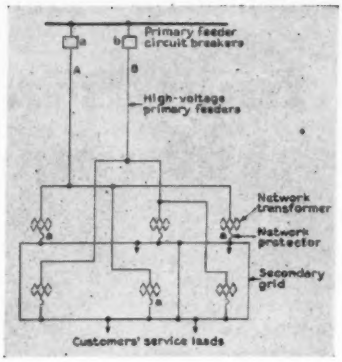


Fig. 3. Schematic circuit diagram of a typical utility a-c secondary network system.

week-ends or at night, without affecting production. Such conditions do not exist on utility systems.

The conditions discussed above can be summarized as followed:

1. Selling power to the public vs using power in your own plant.
2. Underground and wet location vs dry location of cables and transformers, resulting in general, in marked differences in failure rates of cables and transformers in utilities and industrial systems.
3. Long cables with many transformers vs short cables with few transformers.
4. Frequent changes in circuits which must be made without dropping any load vs relatively infrequent changes made when load is off or at a low level.

Consideration of the above conditions tends to favor a system more reliable than the simplest radial type for the utility systems in downtown areas and to question a system more complicated and expensive than the simplest radial type for the average industrial plant, as far as service reliability is concerned. Of course, there are industries where continuous service is essential, but these are relatively few in number.

Economic Comparisons

Secondary network systems, as used by the utilities, have a higher first cost than the simplest radial systems because of four factors:

1. Reserve transformer capacity.
2. Reserve capacity required in primary feeder systems to carry all the load should one feeder fail.
3. Additional secondary cable required to transfer load from one station to another in the case of an outage.
4. Network protectors vs lower cost protective devices for radial systems.

The usual utility radial system is not of the simplest form, however, since it has double transformation as shown in Fig. 2 and thus is more expensive in this field than the network system which has a single transformation as shown in Fig. 3. In general, the simplest radial system (Fig. 4) is not considered of adequate service reliability for utility underground systems where the primary voltages are 11 kv and above.

When additional features are added to improve service reliability of simple radial systems, its cost soon exceeds that of the network. This is outlined in more detail under the paragraph on "Modified Radial Systems".

Network systems cost more than radial systems in industrial plants because of the same cost factors as mentioned for the utility systems. A fifth factor, secondary switchgear (600 volts and below), creates a wider spread between industrial network and radial systems because higher interrupting capacity, low-voltage air-circuit breakers are required in a network to handle the considerably higher short circuit currents. The network has higher short circuit currents because all transformers are paralleled—they are not paralleled in the radial system.

The wide cost differential would tend to make the network system less attractive in the industrial than in the utility field, merely from the standpoint of first cost. However, since the cost of an industrial distribution system is only 2 to 5 per cent of the cost of the total plant, the additional cost of the network should not be a major reason for discarding the network system for an industrial plant if the network possesses other significant advantages over other types of applicable distribution systems.

Operation and Maintenance

With the exception of a few cases, all utility secondary network system low-voltage grids operate at 208Y/120 volts, 3 phase, 4 wire, grounded neutral. At this low voltage, grid faults are generally self clearing[4]. This factor influenced the designs of secondary network so as to eliminate all secondary (208Y/120-volt) switchgear except the network protector.

However, experience with burning faults clear has shown that some faults will burn clear slowly or not

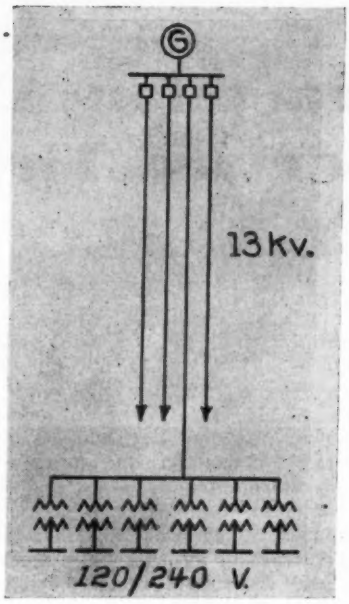


Fig. 4. Circuit diagram of a radial distribution system with single transformation, for utility service.

at all. In some of the cases where grid faults did not clear readily, severe manhole fires and explosions resulted. To remove the stubborn faults before they spread to other parts of the network or before the cable insulation is heated to a point where it may burn or give off explosive gases, limiters[5] — a special form of fuse—were developed by the utilities for sectionalizing the 208Y/120-volt grid.

The elimination of the low-voltage switchgear was also predicted upon working the secondary grid while it is energized. To reduce the hazard of this to the minimum, elaborate safety precautions and well-trained personnel are usually considered necessary. As an example of the safety precautions used, some utilities have a complete set of rubber mats for lining the manholes during such work.

Furthermore, the average large utility has sufficient maintenance and extension work to be done on 208/Y120-volt systems to occupy the time of several men. Since these men do this type of work every day, they are much more qualified to handle the job carefully and efficiently than men working on energized circuits only occasionally as would be the case in industrial plants.

The limiters referred to above offer short circuit protection only and have no means of switching the circuits, hence they do not eliminate the hazard incidental to repairing and maintaining the grid while it is energized.

The utilities have a staff of technically trained personnel and testing laboratories fully capable of handling the network protectors and their associated relays.

In industrial plants most circuits are of 480 volts instead of 208Y/120 volts.

There are no data to show how successfully 480-volt cable faults can be burned clear. Even if they would burn clear, it is generally conceded by operators of industrial distribution systems that the possibility of fire, resulting in damage to surrounding equipment and hazard to

(*Continued on page 55*)

Indoor load-center type unit substation with drawout air circuit breakers and self-cooled three-phase pyranol transformers. This equipment is installed on an industrial distribution system of the radial type.

War Contract for Alternators Keeps Service Firm Busy

By Richard Lane

JERRY C. CLARK, of F-S Electric Company, Memphis, Tennessee, knows a good thing when he sees it. He also knows that after the war there will be more opportunities for electrical manufacturers and service than ever before and that the man who is ready for it is going to get the business. Clark will be ready for it, and with a larger and more experienced organization because war contracts are "booming" his plant and opening an entirely new avenue to postwar enterprise.

Clark's war contracts are unique. They call for electric alternators for portable power plants supplied to the Army Signal Corps, said to be the first manufactured in the South. They are completely equipped to supply power for the armed forces, and when peace comes, Clark hopes he will be ready to turn them out for Southern industry in quantity lots.

The alternators, designated F-S42 and known as "Clark" alternators, are built in sizes ranging from two and three kilowatts to as high as 15 or 25 kilowatts, standard 60-cycle, three-phase or single-phase with direct-connected or built-in exciter.

Before the war, the F-S (Fast Service) Electric Company specialized in the sale and service of heavy duty generators, frequency changers, motors and control equipment for cotton oil mills, cotton gins, hardwood and lumber companies, municipal plants and other concerns located throughout the mid-South.

Several Contracts Obtained

Less than a year ago, the company broadened its scope of service and obtained a contract to manufacture approximately 500 alternators for the Army. The initial contract is now well on the way toward completion and the firm has obtained two additional contracts for more than 1,000 alternators.

The alternators, drip-proof and built to withstand any operating or weather conditions, are being manufactured for a special type engine. Clark's plan for the postwar era is to make them adaptable to any type, or speed, prime mover, so that they can be directly connected to an engine or belt driven.

Present facilities enable the company to manufacture them in quantities of at least 100 a week, Clark declares. When he can manufacture them for private industry, he intends to supply them in eight or 10 different sizes for farms, camps, isolated construction jobs, or for any application which requires standard central station power.

It also is Clark's post-war plan to build standard and special polyphase squirrel-cage motors in all sizes up to and including 25 horsepower.

"Already the first generator manufacturer in the South, this will give the F-S Electric Company the distinction of being the South's first electric motor manufacturer," Jerry Clark believes.

With the emphasis at present on the Clark alternators, the company has drawn up plans for a new addition to the plant on South Third Street. The increase of 25 per cent in floor space and installation of additional equipment will bring an increase of almost 50 per cent in the company's output, Clark reveals. The addition, expected within the next six weeks, will enable F-S Electric to handle the present contracts on schedule and also permit the company to take on many more.

"F-S Electric Company has always been a repair shop since it was founded in 1935," Clark says. "We also have supplied new and rebuilt motors and have done rewinding and general service work. We have endeavored to continue our service to private industry, but because of our war contracts, naturally, such service is now very limited. We haven't wanted to be selective or discriminating in jobs we should or could take, but it has become necessary. At present we are doing only two or

Approximately 75 completed F-S42 or "Clark" alternators manufactured by F-S Electric Co., at Memphis, Tennessee, for Army Signal Corps awaiting shipment. The F-S company is now completing first contract for 500, has other contracts for 1,000 more.

A girl trained to build and assemble main switchboard for alternators, equipped with automatic voltage regulator, frequency meter or speed indicator, total hours of operation meter, ammeters, volt meter, main circuit breaker, remote control starting and stopping outlets, main power studs and convenience outlets.

three per cent of our former repair business. The rest of the plant is geared to war production."

This company already has been feeling the manpower strain, as have all other businesses, but Clark has found a solution well worth the attention of other Southern electrical companies wondering where replacements are coming from for their staffs.

Instead of stringing along with limited personnel, Clark has turned to several of Memphis' larger high schools for students trained in manual arts departments. Both boys and girls have been quick and eager to adapt themselves to work on the alternators. After the war many of them may remain as valuable, experienced employees to help the company in the transition from war contracts to private business.

This company is solving manpower strain by hiring boys and girls trained in manual arts departments of larger Memphis high schools. These two boys have been working several months. They are winding main three-phase alternator rotor. Youths are eager, learn rapidly.

Maintenance Instructions For Fractional Hp Motors

Appliance service men are often called upon to service electric motors and to instruct users in the care and maintenance of them. The motors may be on appliances or performing some other job around the home. It is hoped that this use and care information on the smaller motors will be helpful to the service man in rendering complete service to his customers.

Fractional - horsepower motors have been designed to meet a variety of applications and service conditions, and the maintenance of one special type of motor does not necessarily coincide with that of another type in all ways. In general, this article is written for the types of motors most commonly used in household appliance applications, but the suggestions made will also be found to be applicable to most other types of motors.

The entrance of dirt or lint into a motor can have a harmful effect upon its finely machined parts. For this reason, an attempt should be made to avoid extremely dirty atmospheric conditions.

Machinery and appliance manufacturers who motorize their products with fractional-horsepower motors ordinarily protect the motors from damage caused by dirt by the proper selection of the type of motor used.

Unless conditions are severe, the depositing of dirt on the outside of a motor will cause no damage to it except to present a bad appearance. Dirt on the outside of a motor can be normally wiped off with a dry cloth.

If it is known that excessive dirt has accumulated inside the motor, it should be dismantled and the dirt properly cleaned out.

Moisture Principal Hazard

Moisture, in the form of dampness, condensation, or water coming in direct contact with the motor, causes deterioration of the insulation and corrosion of the metal parts. This can lead to an electrical or mechanical break down of the motor.

Motors should be carefully protected from this condition by locating them in dry places and providing adequate ventilation. Care should be taken to prevent water from coming in direct contact with electric motors.

The most commonly used fractional horsepower motors are designed to operate normally at an approximate ambient temperature of 40 Degrees C (104 degrees F). If the temperature surrounding the motor greatly exceeds this for prolonged periods of time, motor overheating may result. Over heating is injurious to the insulation of the motor and should be avoided by providing adequate ventilation.

In an ambient temperature of 40 degrees C (104 degrees F) at full rated load, the resulting motor operating temperature can be as high as 80 degrees C (176 degrees F). The fact that a motor may be too hot to touch comfortably with the hand does not necessarily indicate overheating.

Fractional - horsepower motors are generally divided into two classes with regard to bearing construction: sleeve bearing motors and ball bearing motors.

Sleeve bearing motors are provided with a sufficient quantity of lubricating oil at the factory to last for a year under normal operating conditions. The addition of several drops of high grade, light mineral oil semi-annually should be sufficient to provide satisfactory lubrication. Motors which are used continuously will require oiling at more frequent intervals.

Do not over oil. Over-oiling frequently allows oil to come in contact with the motor insulation and other internal parts and causes damage leading to shortened life of the motor.

It should be noted that on some types of washing machine motors and fan motors no provision is made for reoiling. The motors are provided with a sufficient quantity of lubricant at the factory to last the life time of the motor.

Ball bearing motors are provided with a sufficient quantity of grease at the factory to last for approximately two years of normal operation. To relubricate these bearings the motor should be completely disassembled, the old grease cleaned out, and a fresh supply of suitable high grade grease properly repacked into the bearings.

Jet pump motors usually have sufficient grease for approximately five years of normal service without attention. At the end of this time the bearings should be serviced as above. It is suggested that the oil screw be removed and five to ten drops of a good grade mineral oil be added to each bearing once a year. For extremely hot conditions more frequent servicing may be necessary.

Improper mounting of a motor is most frequently the cause of worn motor bearings. Such mountings consist generally of poor alignment between the driving and driven pulleys when a machine is belt driven from the motor; poor alignment to the driven shaft when the motor is driving a machine through a direct coupling; mounting the motor in other than a horizontal position (if motor is not suitable for this type of mounting); placing end thrust on motor shaft, (if motor bearings are not designed to take thrust); mounting the motor on an unsteady base; or the motor being insecurely fastened in its own base.

Any of these improper mounting conditions can be easily observed and should be corrected by whatever means are necessary and practical.

A common cause for improper operation of a motor is incorrect power supply at the motor terminals. Incorrect power supply can cause a motor to draw excessive line current and overheat, subsequently damaging the motor windings and insulation; or a marked decrease in motor output.

Improper output can be caused by any of the following conditions:

a. Wrong voltage (too high or too low)

b. Reversed or open phase (polyphase circuits)

c. Wrong frequency

d. Wrong type of power supply (AC for DC, etc.)

e. Inadequate wire size for power supply.

f. Loose connections

g. Improper connections between motor and power line at terminals.

h. Open circuit caused by open switches, blown fuses, etc.

Correction must be made immediately in order to obtain efficient and satisfactory motor operation.

Fractional-horsepower motors are designed to develop their full rated load in accordance with the nameplate marking. When fractional-horsepower motors are sold to manufacturers of machines or appliances, careful checks are usually made to be certain that a motor of the proper rating is supplied. Motor overloads, which are damaging to the windings and insulation, are usually caused by binding or unusual loads on the driven machine.

To prevent overloads make certain that the machine or appliance

(*Continued on page 54*)

GLASS TAPE IMPROVES INSULATION—Insulating tapes as thin as .003 inches are now made from glass and serve many useful purposes such as insulating motor coils, magnet coils, glass-and-mica slot cells, etc. The glass thread is spun from filaments obtained by melting special glass marbles as shown here and drawing the glass through small holes in platinum bushings. A single marble can be drawn into a filament 70 to 100 miles long. (Westinghouse photo.)

Accidents and Rejections Reduced by Better Light

By O. D. Hall

PRODUCTION has been speeded, and quality of workmanship greatly improved through installation of a modern electric lighting system in the office and shops of the Capitol Steel and Iron Co., Oklahoma City, Okla.

This comparatively new plant spreads over 20 acres of attractively landscaped ground. It is engaged almost exclusively on war contracts. It fabricates steel for air depots, airplane hangers, bomber plants, army and navy bases and bridges for highways. It has an average of 300 employees.

Harold L. Pickens, member of the staff of lighting engineers of the Oklahoma Gas and Electric Co., Oklahoma City, Okla., which furnished the plans, said that there is a wide contrast between the old lighting installations, which gave an average of 2 footcandles of illumination, and the new equipment which floods offices and shops with an average of 20 footcandles of shadowless light.

The old lighting in the shops consisted of 1,000-watt, incandescent lamps, with only one lamp for every 3,000 sq. ft. of working area. These were bare lamps without any reflectors whatsoever. The new shop installations are incandescent lighting and consist of fifty 1,000-watt, Guth, High Bay, 18-inch Alzak aluminum reflectors with 30 degree light beam cut-off. Each unit is placed on 20 ft. by 25 ft. centers, about 22 feet above working levels.

These units were installed in three, 300-ft. sections of the main shops building. Each pair of units is connected by two No. 8 conductors, switched from a large breaker-type panel located in the plant.

Referring particularly to the shop lighting, C. Kramer, secretary-treasurer of the Capitol Steel and Iron Co., said: "We have reduced accidents approximately 50 per cent through installation of this new lighting which absolutely eliminates all confusing shadows. Under the old lamps, workmen groped around among shadows cast by machines and stacks of materials. If a section of a machine were mistaken for a shadow, an accident often resulted. Under the old lights we also had much material turned back because of defective workmanship. When confronted with this, workmen almost invariably laid the defects to poor lighting."

Mr. Kramer cited, as one example, drilling operations on steel beams. "Some of the beams," he said, "are too heavy to handle at the stationery drills. It is necessary to operate portable drills on the surfaces of these beams. Marks on the beam indicate where the drill point should enter. But under the old lighting these markings could not be clearly distinguished and holes were drilled at wrong places or slightly off-scale. As a result the beam would not fit engineers' specifications for joining to other parts and the material was rejected. This, of course, resulted in loss of money, and time of workers. These embarrassing features are eliminated by the new lighting under which the finest markings can be distinguished."

First modern lighting installa-

(*Continued on page 52*)

The main shop building of this steel and iron works is illuminated by fifty 1,000-watt incandescent units at 22 ft. above working level. This installation has increased the level of illumination from 2 footcandles to an average of 20 footcandles. One of the principal advantages of new lighting is the elimination of confusing shadows. Management reports marked reduction in accidents and rejected work. The plant is devoted principally to fabrication of steel for defense and highway projects. Above is the well lighted drafting room using eight shielded fluorescent units each consisting of four 40-watt lamps.

The Amplidyne--Versatile Machine For Industrial Process Control

ONE OF THE most important electrical developments of recent years is the amplidyne, which is being applied with numerous advantages to a growing list of duties. Since its first application in the late 1930's, it has improved many existing electric applications and made others practical which were not practical before.

At every step of the way, from the mining of raw materials to the final processing of a wide variety of products, amplidynes are helping set new highs in production and new standards in quality. Applications include mine hoists and power shovels, blast furnace skip hoists, electric furnaces, blooming plate, and cold strip mills, runout tables, flying shears, electrolytic tinplating lines, sawmill carriages, boring mills, and paper machines.

In these and in many other applications, the amplidyne, a product of G-E engineering, is proving its versatility by performing a wide variety of functions, as follows:

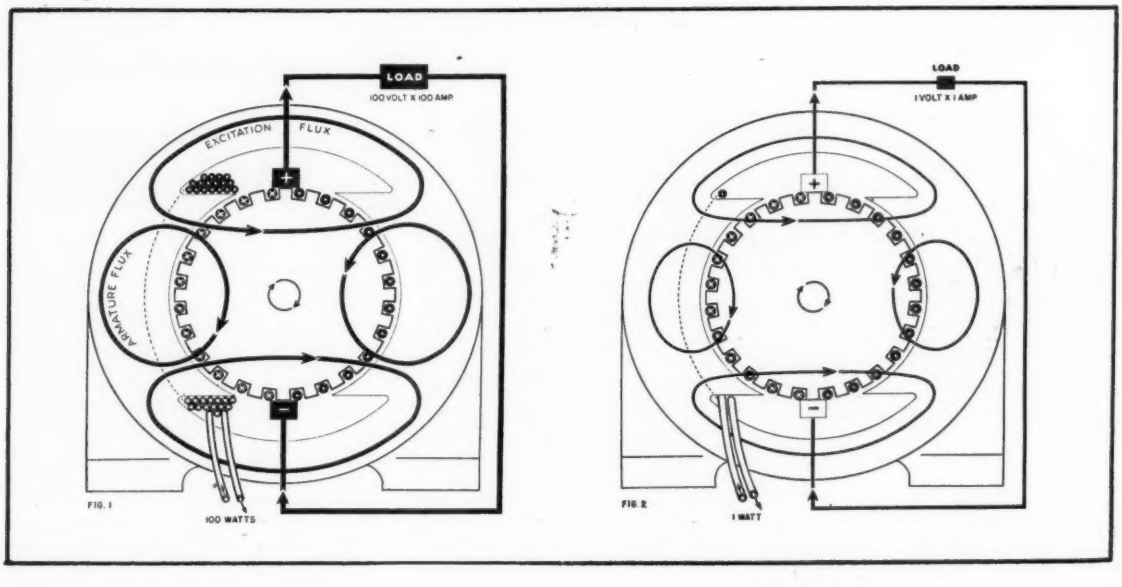
1. It controls speed accurately over a wide range;
2. It limits loads to protect electrical and mechanical equipment;
3. It controls torque and tension to improve product uniformity in winding, drawing, and other similar operations;
4. It speeds up acceleration and deceleration to increase production of high-inertia machines;
5. It positions machine-tools, arc-furnace electrodes, simply and precisely;
6. It regulates current, voltage, power, speed;
7. It can be used with either a-c or d-c equipment;
8. It is a natural partner of electronic devices.

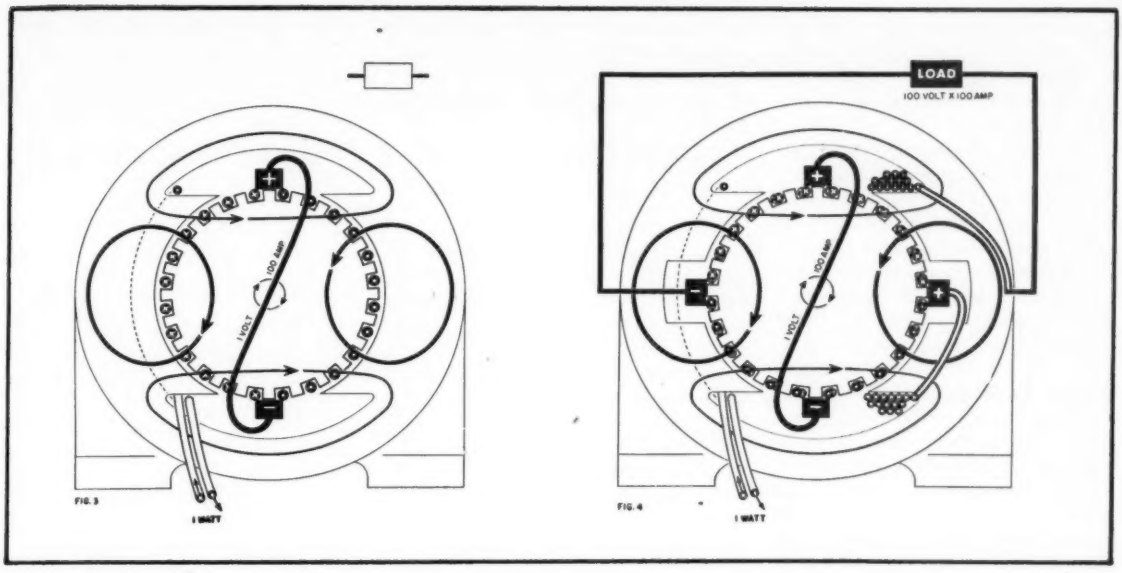
The amplidyne is an externally-driven d-c generator, outwardly similar to a conventional motor or generator. But its ingenious and unique use of a short-circuit and compensating winding creates such precise electrical balance that an electrical signal as small as half a watt will instantly release kilowatts of power capable of controlling the most powerful electrical machine. Figs. 1 through 5 explain this unique principle of the amplidyne.

A conventional two-pole 10-kw d-c generator driven at constant speed may be shown schematically as in Fig. 1. For the sake of simplicity, the armature is shown serving also as commutator and a single exciting field coil is shown on the north pole. The small circles with dots show conductors where the current is directed towards the reader and the small circles with arrow tails show conductors where the current is directed away from the reader.

About 100 watts of excitation power supplied to the field coil creates the excitation flux. This flux is producing a full-load voltage of 100 volts, which circulates 100 amperes full-load current through the load, taken as a resistance of 1 ohm.

The load current, in flowing through the rotating armature conductors, creates a stationary armature flux because the armature conductors on the left of the brush axis always carry current in the same direction and the armature conductors on the right of the brush axis always carry current in the opposite direction. The combined effect is the same as that of a stationary solenoid, producing flux as shown in the

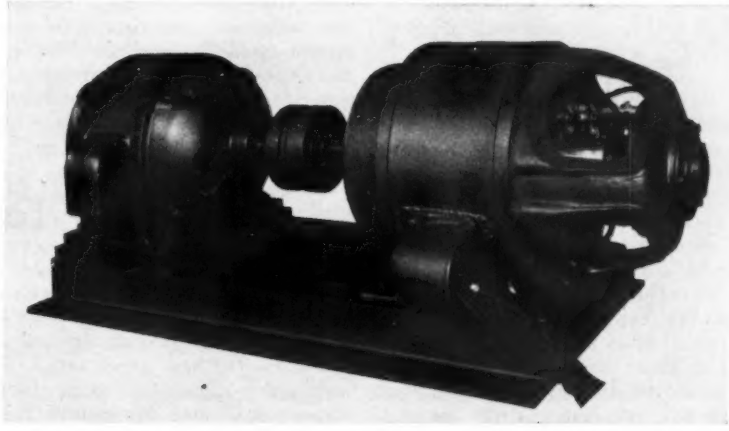




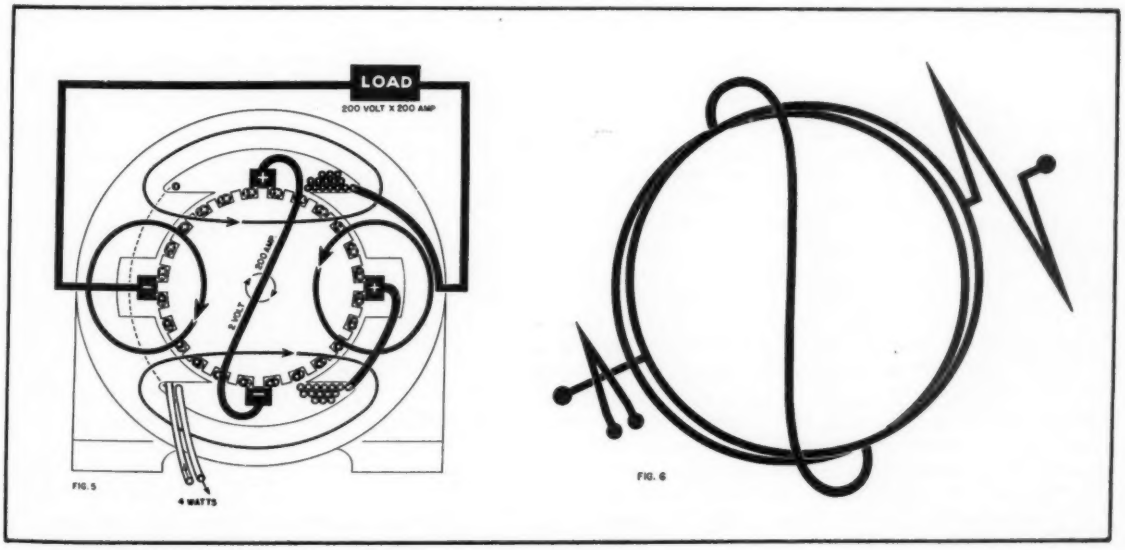
left and right flux loops. This armature flux is of about the same magnitude as the excitation flux but it is not doing any useful work.

Two questions arise: Can this idle armature flux be utilized? Can the excitation power, now too large for accurate control devices, be reduced to a point where small, fast response devices can be used, and yet release the same full output?

With a smaller field coil, and with excitation power reduced from 100 watts to 1 watt, the same conventional generator appears as in Fig. 2. The new reduced excitation power creates only 1 per cent of the original excitation flux. Voltage at the brushes is reduced



Typical amplidyne motor-generator set. See accompanying text for explanation of the circuit diagrams and uses of this versatile machine.



from 100 volts to 1 volt, and the load current, also reduced from 100 amperes to 1 ampere, produces only 1 per cent of the former armature flux.

Thus, one objective has been attained — excitation power has been reduced to a value where it can be readily supplied and handled by precise control devices.

How can we restore full-load working flux and yet retain this low excitation power? A **short circuit** across the brushes, as in Fig. 3, restores the armature current and consequently the armature flux to their full original values. This is because the internal resistance of the armature winding is assumed to be 1/100 of the load circuit resistance. The load has been disconnected. The excitation power and flux continue to be extremely small, but they now control the full-sized armature flux.

Harnessing Armature Flux

But the armature flux is still idle. Can we "harness" it, and put the armature back to work delivering full kilowatt output?

To put the short circuit to work, two new brushes are added, as in Fig. 4, one in the center of each armature flux loop, just as the conventional brushes are located in the center of the excitation flux. Let us assume for a moment that these new brushes are not connected to any load and that we are only measuring the voltage between them. We had assumed in Fig. 1 that the armature flux was of about the same magnitude as the full excitation flux in the same figure. The armature flux being full value produces full voltage, 100 volts, between the new brushes. We now connect these new brushes to the same load—one brush directly, the other through a compensating field shown on the south pole. One hundred amperes, full current, circulates through the load. In the same armature conductors, the new load current adds to and subtracts from the short-circuit current. This is shown by the four different combinations of "dots" and "tails" now seen on the armature conductors.

Note, however, that the new load current in the armature conductors sets up its own armature flux which would be directed from right to left because any tendency in this direction is neutralized by a compensating field of equal and, as shown by the "dots" and "tails," of opposite strength. The ouput of 10,000 watts is released by an excitation power of 1 watt. This is an amplidyne.

The Amplidyne Goes "All Out"

Assume that the excitation current is suddenly doubled (an increase from 1 watt to 4 watts), (Fig. 5). This instantly doubles the short-circuit current, producing double output voltage (200 volts) and forcing double current (200 amperes) through the load Thus, by merely raising the control input by three watts, output is raised from 10 kilowatts to 40. To obtain comparable changes in output in response to minute changes of excitation with conventional generators would require two generators—a small control signal would excite the first one; the output of the first generator would excite the second. The output of this second generator would considerably amplify the small control signal to the first one but with a cumulated delay in response.

In the amplidyne, the equivalent of a full-size exciter (utilizing the same armature structure and conductors) is available to forcibly excite the output generator for fastest response. The speed of response of the amplidyne is further accelerated because the output flux is produced by the armature conductors from within the armature structure so that even the flux which leaks through the air produces useful voltage.

The symbol shown in Fig. 6 graphically represents the amplidyne as two full-sized generators "compressed" into one. The minute control field and the short-circuited circle are identified with the first stage. The compensating field and the other circle connected to the load are identified with the second stage.

The amplidyne provides an entirely new combination of amplification and speed—two stages of amplification faster than any single stage could be.

Easy to work with, the amplidyne is in every outward aspect similar to a conventional exciter. All the user need concern himself with are the excitation input and working output. Because the amplidyne uses only the simplest laws of rotating electrical machines, and because there is practically nothing to wear out, it stays put. The bearings will last a lifetime, and the brushes which handle small currents will run a close second.

In Fig. 6, we have shown the amplidyne as a two-stage amplifier responding to a single control field.

Use of Several Control Fields

If several control fields, independently excited from signal devices, are placed on the same pole structure, the amplidyne will respond to their resultant action and amplify it in the same manner as for a single field.

The small space required by the individual coil makes it possible to have a normal complement of four fields, permitting many independent functions to control the amplidyne output.

Each of these fields is easily adjusted by a small resistor or other means, and since their current requirements are so small, their action may be automatically blocked by small rectifiers as long as a certain operating condition or limit is not reached.

Simplicity—This use of multiple fields in the amplidyne greatly reduces the number and size of control devices required to obtain a certain performance.

Ease of Adjustment — Because they are so small, these fields are easily adjusted within a much wider range than conventional fields. Considerable flexibility is thus built into the equipment permitting operating limits to be easily changed if necessary.

Automatic Operation — Because the small amplidyne fields invite the use of a greater number of controls, automatic operation can be realized to a greater extent.

Peak Performance Under Transient Conditions—Because of the forcing action of the amplidyne, together with its practically instantaneous response, machines excited by the amplidyne are made to deliver maximum performance under fast changing conditions.

High Amplification—As high as 10,000 to 1—is obtained with ease in the amplidyne.

Reliability—Since all these desirable characteristics are built into the system, they become in fact a part of it; and the amplidyne will keep on delivering these characteristics year after year, giving unfailing performance.

Code Panels Feature Meeting Of Inspectors in New Orleans

RECOGNIZING that the objectives of the International Association of Electrical Inspectors were never more important than they are under present-day wartime conditions, the Southern Section of the IAEI will hold its annual meeting in New Orleans, September 27, 28 and 29.

Designed to further the war effort as much as possible, the meeting will feature a series of code discussion periods over which a number of outstanding authorities on the National Electrical Code will preside. These discussions will enable contractors, industrial maintenance electricians, and all other branches of the electrical industry interested in the application and interpretation of the National Electrical Code to obtain expert opinion on the many problems that confront the electrical industry as a result of material shortages, overloading of equipment, and temporary installations.

Members of the Southern Section have been asked to submit their Code questions and problems to the Code Panel Chairman, Frank G. Camus, city electrician, Shreveport, La. The form at the bottom of this page may be used to submit questions, and these should be submitted at the earliest possible moment.

In addition to Mr. Camus, the chairman, the Code Discussion Panel will include such well known Code authorities as Arthur L. Abbott, National Electrical Manufacturers Association, New York; L. F. Adams, General Electric Company, Schenectady, N. Y.; M. M. Brandon, Underwriters Laboratories, Inc., New York City; J. G. Fisher, Mississippi State Rating Bureau, Jackson, Miss.; J. S. Mahan, Consultant, Chicago, Ill.; C. V. Porbes, Louisiana Rating and Fire Prevention Bureau, New Orleans, La.; G. M. Ross, Tennessee Valley Authority, Sheffield, Ala.; B. Z. Segall, New Orleans Public Service, New Orleans, La.; W. A. Stall, City of Jacksonville, Fla.; Frank Thornton, Jr., Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.; Victor H. Tousley, international secretary, IAEI, Chicago, Ill.; and Howard W. Weber, U. S. Rubber Company, New York City.

In addition to the Code discussion sessions, addresses will be presented during the course of the meeting on timely subjects relating to electrical safety. Several inspection trips are being planned. A number of outstanding war plants are located in New Orleans and it is hoped that arrangements can be made for a trip through one of these now in mass production on various types of water craft for the Navy.

Plans for the New Orleans meeting have been under the general direction of B. Z. Segall, chairman of the Meeting Committee. Assisting Mr. Segall is C. V. Porbes, secretary of the Meeting Committee, and the following chairmen of subcommittees: Code Panel, F. G. Camus; Finance, Gus Kraus; Ladies, Mrs. Emma Coleman; Photograph, W. L. Mangan; Printing, C. N. Olivier; Program, George Welman; Publicity, George Carnes; Reception, B. H. Bell; Registration, Sam Foulkes; Trips, I. R. Webre; and Entertainment, E. W. McKinney.

Officers of the Southern Section, for the current administrative year include: President, Paul L. Muller, of New Orleans; First Vice President, Dewey L. Johnson, Atlanta; Second Vice President, E. C. Knox, Miami; Secretary, C. M. Jones, Atlanta; and Assistant Secretary, C. M. Miller, Richmond. George Welman, of New Orleans, is chairman of the Executive Committee. T. W. Bowry of Richmond, Va., is president this year of the International Association.

To Get Your Question Discussed, Write It Below and Mail at Once to the Code Panel!

Mr. Frank G. Camus
Chairman, Code Panel
City Hall, Shreveport, La.

Dear Mr. Camus: Please have the questions below discusesd at the Annual Meeting of the Southern Section, IAEI:

_____

_____

_____

_____

_____

_____

_____

Name_____

Address_____

This form may be used to suggest questions on application and interpretation of the National Electrical Code for use during the Code discussion periods at the forthcoming meeting of the Southern Section, I.A.E.I. The panel of Code experts who will supervise this portion of the program will give consideration to questions on the Code submitted to Mr. Camus.

Maintenance in a Bakery

Although the basic principles of electrical maintenance are the same for any particular piece of equipment, there are many industries which present specific service problems. This is the first of a series of articles discussing such problems.

●

NEVER BEFORE in the past quarter-century has the proper care of electrical power-equipment been more essential than it is right now. And never before during the same period has motor maintenance offered as many serious problems. The manpower shortage, replacement difficulties and the present overloading of outside servicing agencies, all enter into the picture.

In spite of these drawbacks to plant-upkeep efficiency, Gene Chivers, maintenance superintendent for the Holsum Bakery, at South Miami, Florida, has the care of the electrical equipment in his charge pretty well under control.

Except for the fuel-oil heating of ovens, the bakery's production setup is practically all-electric. Electric current mixes dough, conveys it through various processing steps, air conditions it and controls the ovens which bake it.

In addition, electric motors power the machinery which slices the bread, and neatly wraps it in waxed paper. And even slicer-blade-sharpening and pan-greasing apparatus is electrically operated.

Moreover, sundry items of plant equipment not directly associated with production, such as ventilating fans and a 10,000-gallons-per-hour water pump, are motor-driven. For its various powering needs the bakery has a total of approximately 60 motors ranging from a fraction to 40 hp.

Besides electrical and mechanical plant equipment, Chivers is responsible for the upkeep of a 36-unit delivery fleet. While maintenance of the latter is conducted as a separate operation, including personnel, Chivers, has direct supervision over it.

To carry on the mechanical and electrical portions of plant upkeep, he has one assistant—a first-class mechanic. However, a large part of the latter's time is taken up with lubrication and with machinery repairs.

In order to prevent plant-maintenance detail from pyramiding to the point where it is wholly—or even partially — out of control, Chivers has established a fixed upkeep routine. Budgeting the various equipment-servicing items on a daily basis, Chivers committed them to writing in the form of a chart which he keeps in his office.

Originally compiled from apparatus-manufacturers' maintenance specifications, this schedule has been revised, as occasion required, in order to keep detail-procedure in line with equipment changes and shifts in plant operation. Incidentally, some pieces of production machinery now are in use for as long as 22 hours per day.

Powering and other electrical units are set up for attention simultaneously with transmission and other parts of the machine to be serviced.

Determined by the functional character of the equipment-items involved, upkeep routine falls into two principal classifications — semi-weekly and weekly. *However, some scheduled part of the work is done each day.*

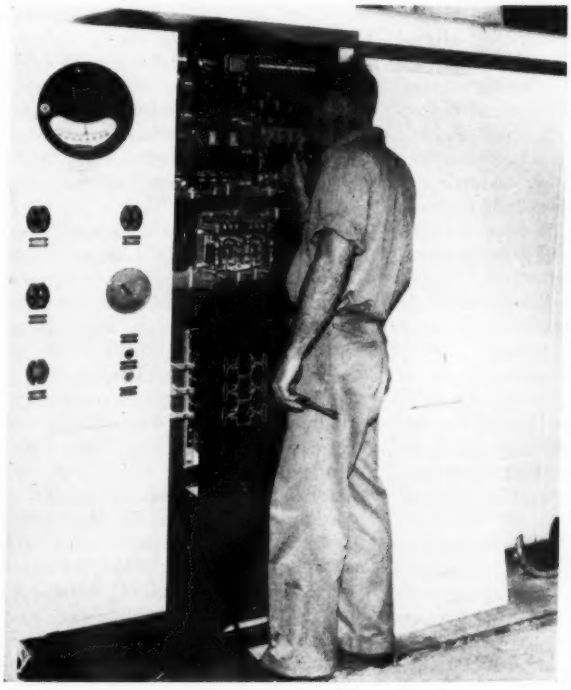
Besides the servicing of a storage-room refrigerating unit and a battery of 36-inch, motor-driven fans for cooling bread, Monday's maintenance calendar provides for the inspection and lubrication of motors and non-electrical moving parts of six production machines.

Tuesday's listing calls for the same routine in regard to four pieces of producing equipment and a baked-bread conveyor — all electric-powered. Included, also, is the servicing of 11 motors essential to the operation of two bread-baking ovens.

Together with other maintenance jobs, Wednesday's schedule specifies the checking and servicing of electrically-operated dough-conditioning apparatus: a refrigeration unit, an air-circulation fan, and a hot-water-circulating pump.

Newt Galloway, bakery maintenance mechanic, lubricates an oven motor. Regular lubrication schedules are followed. At right, Gene Chivers, maintenance superintendent for Holsum Bakery of South Miami, demonstrates the use of his lathe equipment which is used for many reconditioning operations on small motors.

The intricate control mechanism of a baking oven requires regular weekly servicing. Below, contact points are being cleaned. At right, motor bell-end housing is being taken off to permit rotor removal.



In addition to five semi-weekly items on Monday's list, the Thursday program includes the lubrication and compressed-air cleaning of a 5 hp motor which drives flour-sack salvage equipment.

Friday's work-sheet repeats the maintenance routine on three motor-driven production machines which were serviced on Tuesday. And, besides sundry mechanical items, the Friday listing adds the lubrication of a 1 hp motor and the careful checking of all electrical parts, such as switches and contact points, which actuate the dough-hoisting apparatus.

There are safety as well as maintenance factors involved in this detail. In lifting dough and container—nearly 1,500 lbs.—the hoist raises its load almost to ceiling height. Therefore, any mechanical or electrical failure might result in a serious accident.

On Saturday the plant is closed down. Consequently, this day is used to take care of all weekly items which cannot be done properly, when machinery is in operation, or for which there was no time earlier in the week. A large part of Saturday's work is electrical, and includes the servicing of the intricate mechanisms which control oven-temperatures, the automatic operation of traveling trays and other oven machinery.

An excellent idea of the detail set up by Chiver's weekly upkeep chart may be gained by a glance at the instructions listed for the servicing of a 1,000-lb. dough mixer: (1) Clean and file electric contact points, (2) clean fuses and holders, (3) check door-motor electric brake, (4) clean push-button contacts. Other items on the schedule for this particular piece of equipment cover non-electrical work.

Before coming to the Holsum Bakery about seven years ago, Chivers had public-utility experience. For this and other reasons, he is decidedly "motor-minded." Knowing that dirt is destructive to electric motors, he takes especial pains to keep them as dust-free as possible. This he does by blowing them out at frequent intervals—weekly, if he can manage it—with air under high pressure.

Another of his pet upkeep-phobias is under-lubrication. "The best of lubricants," Chivers asserts, "are infinitely less expensive than motor replacements—if one could get the replacements."

Two other points he emphasizes is the selection of the right kind of lubricant for any given type of motor-construction and proper application of the oil or grease used.

Ring type bearings, in Chivers' opinion, require a light oil which resists capillary action, and remains in the bearing instead of creeping. For this reason it should not be used for bearings fed by the wick system of lubrication.

For the latter purpose, Chivers gets excellent results by the use of high-grade automotive crankcase oil having a viscosity of SAE 30. This type of oil is designed to flow freely over metal surfaces, and is highly heat-resistant, a quality essential in a good electric-motor lubricant.

In some motor types having wick-fed bearing lubrication, the wicks are readily removable. If they are, they should be washed out frequently in gasoline or mineral spirits to remove any accumulated grit, or they should be replaced by new wicks.

When such motors have to be

dis-assembled, wicks always should be renewed and oil reservoirs cleaned out before refilling with fresh lubricant. In replacing a wick in a motor which has been torn down, the former should be inserted *after* re-assembling the motor in order that no part of the wick can become caught between bearing and shaft.

In greasing ball-bearing type motors, designed for pressure-gun lubrication, extreme caution must be used to avoid the application of excess grease. Equal care must be taken, too, in repacking bearings of this kind, when motors are dis-assembled. In either case too much lubricant may result in overheating and in a thinning of the grease to the point where it runs into the windings. And here, again, the best grade of ball-bearing lubricant obtainable will prove to be cheapest in the end.

Except for an occasional armature-wind job which Chivers has done outside, he and his assistant do, themselves, all needed motor reconditioning. The bakery's maintenance shop is equipped with a lathe, having a 9-inch swing and 54-inch bed, and with all lathe accessories, such as micrometers and commutator cutting tools. With this equipment, Chivers claims, much motor "rehabilitation" may be done.

Most three-phase induction motors of 10 hp or less, he has found, may be serviced without detaching feed-circuit wires or main frame. Bell-end housings and, then, rotor may be removed. However, in the case of ball-bearing type motors especial care should be exercised in the removal of bell-end housings. The latter should be freed from the rest of the construction by use of a gear puller or by tapping with a soft-metal hammer. A block of wood and a machinist's hammer will serve, if no other means is at hand.

The reason for this caution is that ball bearings usually are pressed onto the rotor shaft, and driven into the bell-end housings. Therefore, rough handling may injure one or more of the parts involved.

If hydraulic-press equipment is not available for installing removed or replacement bearings, they may be driven into place by hammer blows against a short length of brass pipe, the diameter of which is just large enough to fit over the rotor shaft. Care must be taken, however, to start the bearing on the shaft evenly at all points.

Once the rotor is out, a number of servicing operations readily may be performed. Bearings may be cleaned and micrometer-checked for wear. Bearing replacements may be made. The rotor shaft may be lathe-tested for correct alignment. And shaft end-play on sleeve-bearing type motors may be checked and remedied, if found to be excessive, by the application of fiber washers.

Too much end play causes excessive bearing wear. Insufficient clearance may result in the overheating of the bearings and in warping the rotor shaft, itself. This in turn may cause the shaft to bind with a consequent overheating of field windings.

Incidentally, the application of insulating varnish to cracked winding insulation tends to restore its oil-and-moisture-resisting properties, thus preventing a possible short circuit and a burned-out motor.

Reconditioning jobs, such as the overhauling of motors, Chivers fits into his work-week along with his scheduled plant-upkeep operations. The latter are set up to take only part of a working day, thus leaving free time for other maintenance items or for "emergencies."

The best proof that Chivers' upkeep system is 100 per cent practical lies in the fact that Holsum Bakery rarely experiences a failure of its powering units, or, for that matter, of the mechanical portions of its plant equipment.

Small Motor Commutator Burnishing Tool

The failure of small motors to operate efficiently can in many cases be traced to glaze or smut deposited on the commutator. This can be attributed to atmospheric conditions, fume and dust conditions and many other hazards, too numerous to mention, also in many instances to the wrong grade of brush material. One of the evils of a dirty commutator is excessive sparking which is not only injurious to the commutator and the brushes but causes radio interference.

In the past many methods to clean commutators have been attempted. No self-respecting mechanic would use emery cloth or sandpaper on a machine with moving parts. Emery or sand will imbed itself into the brush face as well as the commutator. Loose particles in combination with other foreign matter deposit themselves into the slots and cause short circuits between the bars, likewise the windings. They also work themselves into the bearings and brush faces.

To eliminate poor commutation as a result of dirty commutators also the devastating use of sandpaper or emery cloth, our research engineers conducted exhaustive experiments in the laboratory as well as in practice. The result is an unusual resilient material which gives that final touch to a commutator electrical men have been seeking since the advent of motors and generators where a a wiping contact is necessary between a rotating commutator and a stationary brush. This material is at once economical, effective, and efficient. It will hone the commutator to a degree impossible with the finest type of cutting tool or stone and will keep it that way with periodical application at the discretion of the operator.

Non-Conductive Material Used

All the materials used in the construction of this burnisher are non-conductive. Therefore, it can be used safely on a live machine while running. No special preparation is necessary, simply a little pressure applied with the hands. Application in this manner for a few moments will remove the smut or glaze and will restore the machine to its former efficiency. It is as easy as using an eraser.

From the illustration, it can be seen that the tool is designed for double duty. The small end for the smaller types of fractional horsepower motors and the large end for the larger types. Full size is six inches long and so constructed that the wood can be cut away as the burnishing material is exhausted. In other words, sharpened like a pencil and carried like a pencil.

It will service many types of fractional horse power motors.—*Ohio Carbon Co., Cleveland.*

Reconnecting Three-phase Motors For New Voltage Conditions

By A. C. Roe*

METHODS OF reconnecting three-phase induction motors for new voltages with a view of conserving critical materials and man-hours were discussed in the last article of this series, in the June issue of ELECTRICAL SOUTH, page 28. In this issue, the discussion is continued.

There is another item that can be changed to vary the voltage when rewinding. This is the chord factor, which may be changed by changing the coil pitch. The chord factor depends entirely on the pitch and the number of poles, and it will be the same for any number of phases.

The chord factor is equal to the sin of one-half the electrical angle included between the two halves of one coil. In practice, the chord factor is found as follows: First, divide the total number of slots (N) by the number of poles (P). This gives the number of slots per pole. Then take the coil pitch (C) and divide it by the number of slots per pole. This will give the pitch as a fraction of full pitch. Multiply 90° by this fraction and the result will be a certain number of degrees. Then the sin of this angle equals the chord factor. These steps may be reduced to one formula which is:

Chord factor = sin (C ÷ N/P) x 90°.

(Note: First divide N by P. Then divide C by this answer and multiply by 90.)

In this formula: N = total number of slots; P = number of poles; C = coil pitch.

The sin may be found from Table I, in this article or from other tables in handbooks.

As an example, assume a 96-slot, four-pole stator, with coil pitch of 1-and-20, or 19 slots. The chord factor equals sin [19 ÷ (96/4)] x 90 = (19/24) x 90 = .79125 x 90 = sin 71.21 deg. In many tables, the fraction of a degree is expressed in "minutes" and consequently the .21 of the 71.21 must be reduced to minutes. There are 60 min. per 1 deg.; therefore 60 x .21 = 12 min.

The sin of this angle 71.21 deg. (or 70° 12′) equals .9466, which is the chord factor. If the voltage of the motor with full pitch was 100 volts, it would be 94.66 volts with the above-mentioned pitch of 1-and-20 (19 slots).

Suppose that in the example given above it was found that 18 turns per coil would be correct for a line voltage of 440 with a full pitch coil, 1 and 25. However, the coil ends with this pitch projected out beyond the iron too far and interfered with the end bells. To wind properly, the coil had to be shortened to a pitch of 1 and 20.

Now, shortening the coil pitch decreases the activity of the coil sides and the coil will develop less voltage. This is easily understood because we know that with full pitch both halves of the coil is developing its maximum voltage; but when the pitch is shortened, one side of the coil will be in a weaker field and the coil will develop a lower voltage. So changing the coil pitch has practically the same effect on the voltage as changing the turns per coil; decreasing the coil pitch decreases the voltage.

The amount of change is indicated by the chord factor. In the above case the chord factor is

Table I—Chord Factors for Various Values of Per Cent Coil Pitch

Per Cent Pitch	Chord Factor	Per Cent Pitch	Chord Factor
100	1.0000	75	.9239
99	.9999	74	.9177
98	.9995	73	.9114
97	.9989	72	.9048
96	.9980	71	.8980
95	.9969	70	.8910
94	.9956	69	.8838
93	.9940	68	.8763
92	.9921	67	8686
91	.9900	66	.8670
90	.9877	65	.8526
89	.9851	64	.8443
88	.9823	63	.8358
87	.9792	62	.8271
86	.9759	61	.8182
85	.9723	60	.8090
84	.9686	59	.7997
83	.9646	58	.7902
82	.9603	57	.7804
81	.9558	56	.7705
80	.9511	55	.7604
79	.9461	54	.7501
78	.9409	53	.7396
77	.9354	52	.7292
76	.9298	51	.7181

"Per Cent Pitch" is found by dividing the coil pitch by the number of slots per pole.
"Chord Factor" is the sine of the angle obtained by multiplying 90 degrees by the per cent pitch.

*Mr. Roe is motor engineer for Westinghouse Electric and Manufacturing Company.

.9466 for coil pitch 1 and 20; then the line voltage would be 440 x .9466, equals 416.40 volts. To bring the voltage back to 440, the turns would have to be increased 5.6 per cent, or 18 x 1.056, equals 19.006 turns. In this case, dropping five slots has the same effect as dropping one turn per coil.

A simple tabulation of chord factors is shown in Table I. In this table, the first column gives the pitch in the percentage of full pitch. The second column gives the chord factor corresponding to this percentage of pitch. As an example of the use of this table, assume a six-pole, 120-slot stator with a pitch of 1 and 19 or 18 slots. Full pitch equals 120 ÷ 6 equals 20 slots. The present pitch is 18/20 or 90 per cent of full pitch. From the table, we find that for 90 per cent pitch the chord factor is 0.988.

Many a time when rewinding a stator, the coils are accidentally made up a bit short, thus making a tight winding job. Another time, the end room on the original winding may have been scant, so that if the same pitch is used, when rewinding, the job will again be difficult to handle.

Effect of Pitch Change

In either case, dropping one or two slots may ease things up and make a quicker and safer job, but the question is how this will affect the machine. As already stated, reducing the voltage of a generator while operating on the original line voltage will reduce its overload capacity, and in a motor, will cause the motor to operate on overvoltage, the effects of which will be more fully explained later in this article. In general, the effect of dropping one slot will be less in a machine with a large number of slots and a small number of poles. In any machine, if the effect is not greater than 7 per cent, no harm will result from reducing the pitch except in cases where the machine is already being pushed to or beyond its rated capacity. In this case, any change that tends to reduce capacity should be avoided.

Another case in which a better job resulted from decreasing the pitch came up in connection with the rewinding of a stator in which the winding was tight. This was a 120-slot, eight-pole, 220-volt stator with a pitch of 1 and 13, or 80 per cent. The winding was made up of pulled and insulated diamond-shaped coils. Before pulling the new set of coils, it was decided to try the 1 and 12 pitch, which would increase the winding angle and make a better job. The 1 and 13 chord factor is [12 ÷ (120/8)] x 90 = 12/15 x 90 = 72°. The sin of 72° = 0.951. The chord factor of the 1-and-12 pitch is sin [11 ÷ (120/8)] x 90 = 11/15 x 90 = 65.97 = sin 66°, which is 0.913. Then by using the 1-and-12 pitch the voltage would be reduced to 220 x (0.913/0.951) = 211.2 volts. This is a reduction of 220 — 211.2 = 8.8 volts. In percentage this is (8.8/220) x 100, or 4 per cent and the motor will operate satisfactorily with this reduction, as a 7 per cent change is allowable. Now if this stator had 180 slots and was a six-pole machine with 80 per cent pitch, which equals 24 slots or 1 and 25, and the pitch was dropped to 1 and 24, the reduction in voltage would be less. From Table I the chord factor for the 80 per cent pitch is 0.951. The 1 and 24 chord factor (76.7 per cent pitch), is 0.93. The new line voltage is 220 x (.934/.951) = 216 volts. This is (220-216)/220 x 100 equals 1.8 per cent reduction. Comparing this with the reduction of 4 per cent in the previous case proves the statement that the greater the number of slots and the less the number of poles, the smaller will be the effect of one slot dropped.

Another case in which time was saved by eliminating a cross-over coil occurred on a recent rush and overtime rewinding job. The motor had a 120-slot stator, rated 20 hp, 440 volts, three-phase, 60 cycles, ten-pole, 675 rpm, connected series-delta, pitch 1 and 9, coils with ten turns of one No. 11 round dcc wire wound 2 x 5 cross-over, diamond shape, and connected in a two-layer, threaded-in winding. To save time, the winding was checked to see if the cross-over could be eliminated.

There were 120 coils or forty per phase and 40 x 10 equals 400 turns per phase. Then with a series-delta connection the volts per turn is 440/400 = 1.1. Now using a five-turn coil of two No. 11 wires in parallel in a series-star connection, the voltage would be 5 x 1.1 x 40 x 1.73 = 380.6, which is 16 per cent under the required voltage. This, however, was raised by increasing the pitch and chord factor. The original pitch was 1 and 9, which gives a chord factor of 0.866. Full pitch would, of course, give 100 per cent chord factor. Then with the full pitch (1 and 13) five-turn coil and series-star connection the line voltage would be 380.6/.866 = 439.4 volts, which is close enough. Checking the end room it was found sufficient to take the longer coil.

Over-Voltage Effects

With over-voltage, the magnetizing current will vary as the square of the voltage, if the iron is working below the saturation point. This current should be expressed as a percentage of the total current. The iron losses will be increased approximately 1.8 times the per cent voltage increase. This value holds only for increases of voltage of 10 or 15 per cent.

The copper losses will be lower, due to the fact that with a higher voltage a smaller current will be required for the same hp rating.

The slip (or the difference, expressed as a percentage, between the no-load and full-load rpm) will vary inversely as the square of the voltage or:

$S_1/S_2 = V_1^2/V_2^2$, wherein S_1 equals the per cent slip at rated voltage, V_1, and S_2 is the per cent slip at the higher or new voltage, V_2. The power factor will be slightly lower at the increased voltage. The maximum or pull-out and starting torques are increased in proportion to the square of the voltage. The decrease in copper losses more than offsets the increased iron losses.

For 10 to 15 per cent voltage difference from standard, the friction and windage can be assumed to be the same, as these two depend upon a variation in speed and the per cent of change in speed is too small to affect these factors to any extent.

If the motor were not loaded to its maximum rating the effects of over-voltage would be more noticeable. The lighter the load, the greater the iron loss will be in proportion to the copper losses. Also, the decrease in power factor at light loads is more evident as the magnetizing current is increased. With a 15 per cent voltage increase and one-half load, the motor is quite likely to run hot enough to burn out.

But on the other hand if the motor were overloaded and the voltage increased, the motor would run cooler, as the torque increases as the square of the voltage and the speed remains the same. Hence with an increase in torque, the horsepower rating would be increased with a lower current consumption. Or the number of turns per phase could be decreased in the desired percentage to get the effect of overvoltage. This can be carried up to the pull-out torque point of the motor, but for good results should be stopped within 20 per cent of the pull-out torque.

The percentage change in these factors varies in different machines; thus, we can't state that 10 per cent change in voltage up or down will have a certain per cent change in each of these factors. It is certain that the higher the per cent overvoltage, the greater will be the effect on the factors mentioned and on the operation of the motor.

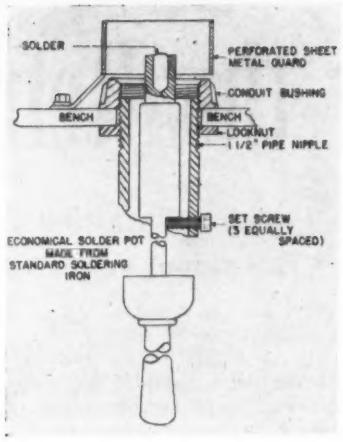
The diagrams and data provided in this magazine over the past year and a half will also be found useful in these times when motors must be adopted to operate under different conditions.

Soldering Iron Makes Efficient Soldering Pot

The use of standard soldering irons especially adapted as small soldering pots has facilitated the production of small instrument-type motors in one of General Electric's works. Because they present only a very small area for oxidation, the irons are saving materials.

The improvised solder pot is easily built. A standard medium-size soldering iron tip is faced off flat and drilled with a ¼-inch diameter hole, ¾-inch deep. This tip is reassembled to the soldering iron. The iron is then mounted vertically in a hole in the bench so that the tip projects about two inches above the top. The mounting is made permanent by the use of a standard pipe nipple locked from the top with an electrician's conduit bushing and from the bottom with an electrician's lock nut. The iron is held in the bushing by three set screws which clamp the body of the iron proper.

Only the insulation contained in the iron itself is required for efficient operation. A perforated sheet-metal guard which encircles the exposed tip permits free circulation of air about the tip, eliminating the possibility of overheating the solder, and at the same time assures complete operational safety by guarding against accidental contact with the heated tip.



Service Work Pushed By Contracting Firm

By a gradual process, the Dyer Electric Company, of Birmingham, Ala., is building up its service department as its volume of new construction declines.

In the past, this concern has handled some of the biggest wiring contracts in its territory. This included the electrical work on the new Sears, Roebuck & Co. store, in Birmingham, on the department store of Loveman, Joseph & Loeb, on the new Kress Store, on the Medical Arts Building, and more recently several big housing jobs. The company still has important war plant jobs uncompleted as yet, but this new construction will continue probably to show a decline.

The service shop was established several years back and naturally during the lush years played second fiddle to the wiring department, but not so now. It has come definitely to the forefront and is being advertised by the company in the newspapers and by direct mail.

Now that the demand is to keep industry running on a 100 per cent basis, this concern is offering a 24-hour motor repair service. It repairs and rewinds motors up to 1200 horsepower and three telephones are listed for night service calls. Recently, on a rush job a motor was rewound in six hours time, this of course being an extreme case. But the slogan is speed and more speed and that is what customers want.

"We take pride in the fact that many concerns for which we did new work are now calling on us for service," said C. S. Dyer, executive of this concern. "It's a case, we believe, of a job well done in one department making business for another department. We find that

(Continued on page 54)

View in service shop of Dyer Electric Co., Birmingham. E. T. Cox, center, and Earle M. Minyard, right, shop foreman, are examining a motor which is being rewound.

Servicing the Refrigerator

Part 5 – Servicing Expansion Valves

THE EFFICIENCY of an entire refrigeration system may be seriously impaired by inaccuracy of the liquid control valve, regulating the supply of liquid refrigerant to the evaporator. The valve may feed more liquid than can be vaporized in the evaporator, resulting in drops of liquid entering the suction line or heat exchanger. These drops of liquid may even return to the compressor and enter the cylinder. This poor quality suction vapor can have only two results: a reduction will occur in the net refrigeration effect gained from each pound of refrigerant circulated; and a reduction will occur in pounds of vapor handled by the compressor due to vaporization of the drops of liquid in the cylinder, thus preventing useful vapor entering the cylinder from the evaporator.

In other cases, the valve may not supply the quantity of liquid refrigerant that can be vaporized in the evaporator, thus not using all of the evaporator surface. This starving effect lowers the suction pressure and therefore reduces the capacity of the system.

To obtain maximum capacity from the refrigeration system, the liquid control valve must keep the entire interior surface of the evaporator wet with liquid refrigerant at all times, and yet not permit raw liquid to pass into the suction line. In order for the refrigerant vapor to leave the evaporator completely vaporized, it is necessary for the vapor to leave the evaporator in a slightly superheated condition. Superheat is the sensible heat gained by the vapor which raises its temperature above the boiling point of saturation point, corresponding to its pressure. Superheat is expressed in terms of effect rather than quantity. Instead of using the number of BTU's gained, it is expressed in degrees—the number of degrees which the heat has raised the temperature of the vapor above its boiling point.

The expansion valve is one of the most widely used methods of controlling the flow of liquid refrigerant into the evaporator or cooling unit. It serves as a device to separate the high side from the low side of a system and in this capacity acts as a metering device for regulating the flow of refrigerant to the cooling unit.

There are two general types of expansion valves in use; the automatic and the thermostatic. The term automatic is apt to be a bit confusing. Both types of valves are entirely automatic in action, once they have been properly manually adjusted.

The automatic type expansion valve is frequently known as the pressure type, because it is actuated by pressure alone. A study of Figures 1 and 2 will show the construction of two general designs of automatic valves. When the valve is closed, the valve spring (8) holds the valve (5) against the seat (4). While the condensing unit is operating, the compressor is pumping the vapor from the cooling unit.

Automatic or Pressure Type

As the pressure of the refrigerant in the cooling unit decreases, due to the pumping of the compressor, the pressure also decreases against the inside of the bellows (14). The inside of the bellows is always subjected to approximately the cooling unit inlet pressure. This vapor pressure, along with the pressure of valve spring (8), is always trying to close the valve. The adjusting spring (10) is so located that the pressure exerted by it is always trying to open the valve. When the cooling unit pressure has decreased sufficiently to allow the adjusting spring pressure to overbalance the valve spring, the adjusting spring, through the operating pin or arm (9), forces open the valve admitting liquid refrigerant to the cooling unit.

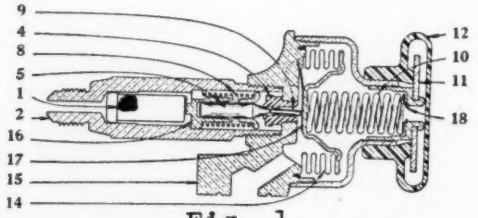


Fig. 1

1. Strainer
2. Liquid line connection
4. Valve seat
5. Valve
8. Valve spring
9. Valve operating pin
10. Adjusting spring
11. Adjusting screw
12. Bellows case cap
14. Bellows
15. Body
16. Valve guide
17. Valve operating pin retainer
18. Adjusting spring guide

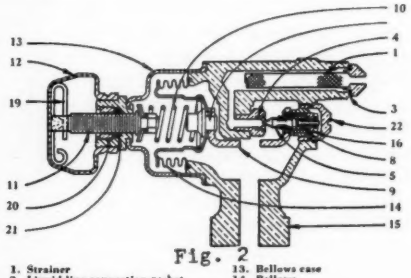


Fig. 2

1. Strainer
3. Liquid line connection gasket
4. Valve seat
5. Valve
8. Valve spring
9. Valve operating arm
10. Adjusting spring
11. Adjusting screw
12. Bellows case cap
13. Bellows case
14. Bellows
15. Body
16. Valve guide
19. Adjusting screw handle
20. Adjusting screw seal gland
21. Adjusting screw seal
22. Valve plug

Figures 1 to 5 show detailed construction of various types of expansion valves in common use.

The liquid refrigerant enters the cooling unit until the pressure in the cooling unit is the normal vaporizing pressure (determined by the adjustment on the adjusting spring), at which point the valve spring pressure and the cooling unit pressure overbalance the adjusting spring and the valve closes. These movements are small, occur in rapid succession, and result in the suction pressure remaining almost constant.

Since expansion is usually below 32 degrees F and the outside of the bellows is subjected to atmospheric pressure and conditions, the bellows must be protected from the freezing of condensation, which will interfere with, or completely stop, its normal operation. This is accomplished by fitting a flexible rubber cap (12) over the end of the bellows case (13).

The pressure type expansion valve is simple in construction and adjustment. For small loads, where the load conditions are fairly constant, it has been used with much success by a number of refrigeration manufacturers. The higher the evaporator pressure becomes during the off cycle, the more the pressure tends to keep the valve closed. This effectively prevents any leakage of liquid refrigerant into the cooling unit during the off cycle.

Thermostatic Type

The thermostatic expansion valve gets its name from the use of a thermal bulb, whose pressure actuates the valve.

Figures 3, 4 and 5 illustrate the construction of three general designs of thermostatic valves. There are four main forces that control the operation of this valve. Two of these forces tend to open the valve and the other two tend to close it.

The bulb (24), connecting tube (25) and the chamber of diaphragm or bellows (27) are charged with refrigerant. This assembly is hereafter called the "power element." In some designs, the same refrigerant is used in the power element as in the system for which the valve was designed. In other designs, a different refrigerant is used in the bulb.

The pressure in the refrigerant charged power element is determined by the temperature of the bulb. Since the bulb is attached to the suction line at the evaporator outlet, its temperature, and therefore the pressure in the bulb, is a definite function of the temperature of the refrigerant at the point of bulb location as it leaves the evaporator.

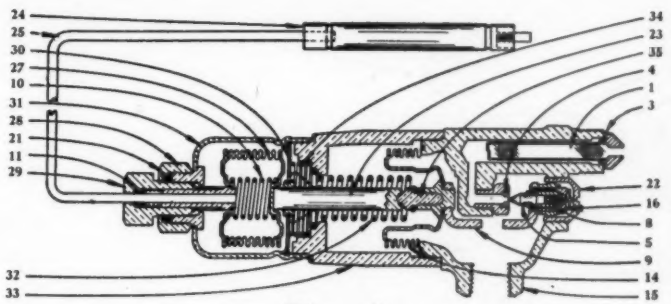
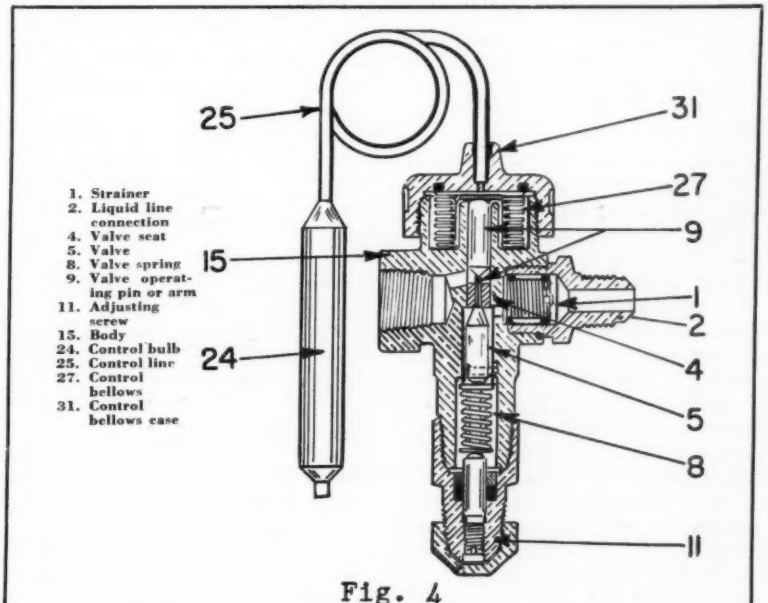


Fig. 3

1. Strainer
3. Liquid line connection gasket
4. Valve seat
5. Valve
8. Valve spring
9. Valve operating pin or arm
10. Adjusting spring
11. Adjusting screw
14. Valve bellows
15. Body
16. Valve guide
21. Adjusting screw seal
22. Valve plug
23. Control pin
24. Control bulb
25. Control line
27. Control bellows
28. Adjusting screw lock nut
29. Control line seal
30. Control pin guide
31. Control bellows case
32. Valve bellows spring
33. Valve bellows case
34. Control pin guide spring
35. Control pin pivot

Just how definite a function of the leaving vapor temperature this will be, will depend upon the method of attaching the bulb to the evaporator outlet. A valve with the bulb loosely strapped, with insufficient thermal contact at the evaporator outlet, will operate entirely different than one with the bulb securely attached, giving sufficient thermal contact.

In the diaphragm type valve the pressure in the bulb is transmitted to the diaphragm chamber and there it is imposed upon the diaphragm. The non-adjustable spring (36) located in the chamber, exerts a constant force upon the diaphragm. The sum of the bulb pressure and spring pressure is transmitted to the valve needle (5) by means of an operating pin (9). This pressure tends to move the valve



1. Strainer
2. Liquid line connection
4. Valve seat
5. Valve
8. Valve spring
9. Valve operating pin or arm
11. Adjusting screw
15. Body
24. Control bulb
25. Control line
27. Control bellows
31. Control bellows case

Fig. 4

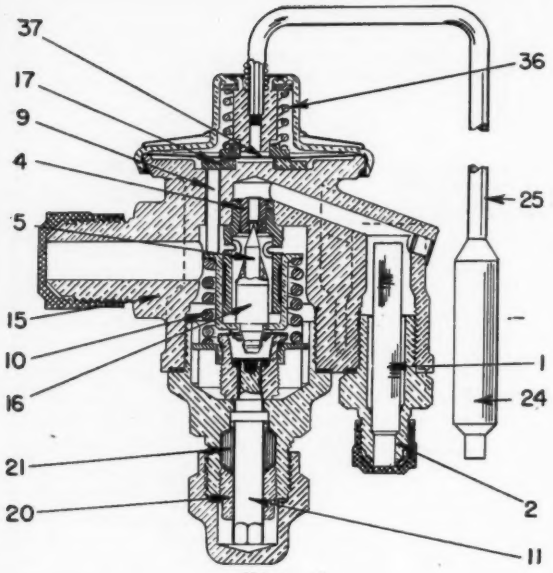


Fig. 5

1. Strainer
2. Liquid line connection
4. Valve seat
5. Valve
9. Valve operating pin or arm
10. Adjusting spring
11. Adjusting screw
15. Body
16. Valve guide
17. Valve operating pin retainer
20. Adjusting screw seal gland
21. Adjusting screw seal
24. Control bulb
25. Control line
36. Diaphragm spring
37. Diaphragm

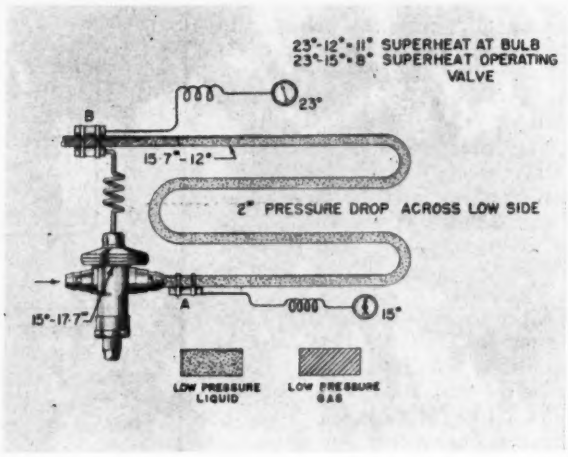


Fig. 6. Method of connecting two thermometers to facilitate adjustment of thermostatic expansion valves.

needle in the direction of opening. Opposing this pressure is a third force exerted by an adjustable spring (10). The force of the adjustable spring tends to move the valve needle in the closing direction and is the means of obtaining a valve setting for any degree of superheat within the valve's range. The fourth operating force is a pressure approximating the evaporator inlet pressure and is exerted by vapor pressure on the valve needle side of the diaphragm. This force combined with the force of the adjusting spring, both oppose the combined force of bulb and non-adjustable spring and tend to move the valve in the direction of closing.

Whenever the sum of the power element pressure and the non-adjustable spring is greater than the sum of the evaporator inlet pressure and adjustable spring, the valve will open. Conversely, whenever it is less than the opposing pressure, the valve will close.

Analysis of these four operating forces indicate that as the temperature of the refrigerant vapor at the point of the bulb location increases, the pressure in the bulb increases and the valve tends to open. However, when the valve opens, the valve outlet pressure increases and this pressure is transmitted to the diaphragm chamber and opposes the bulb pressure. Therefore the temperature and pressure of the bulb must increase to a greater extent than the pressure in the opposing diaphragm chamber, if the valve is to stay open.

This greater increase in bulb pressure beyond the corresponding increase in valve outlet pressure is accomplished in the following manner. When the suction vapor at the point of the bulb location is superheated by the surrounding air in the refrigerated space, its temperature is higher than the temperature corresponding to its saturated pressure. Since the bulb is in contact with the superheated vapor, the bulb temperature will correspond to the temperature of the superheated vapor. The refrigerant contained in the bulb will generate a pressure in the bulb corresponding to the higher temperature of the superheated suction vapor. Therefore, as long as the suction vapor at the bulb location is superheated sufficiently, the total pressure in the power element will be higher than the opposing pressure in the diaphragm chamber and the valve will remain open.

When the condensing unit stops and a saturated condition of vapor exists at the bulb location, the power element force is considerably less and now the combined force of the bulb pressure and the non-adjustable spring is less than the adjustable spring and the valve outlet force in the diaphragm chamber. This holds the valve needle closed on the off cycle and prevents the leakage of liquid refrigerant into the evaporator.

All thermostatic expansion valves operate along the same general principles as dscribed for the diaphragm valve. There are a number of different designs on the market which utilize different details of construction. The manufacturers literature should be studied for complete details.

Installation of Valves

The pressure type expansion valve should be installed at the inlet connection of the cooling unit and in such a position that it may be reached easily for adjustment.

A safe rule to follow in the installation of the thermostatic type valve is to put the expansion valve body in a warmer location than the bulb location. On a vapor charged, bellows type valve, this prevents liquid from being transferred to the bellows from the bulb and allows the bulb temperature to be the controlling factor in the valve operation.

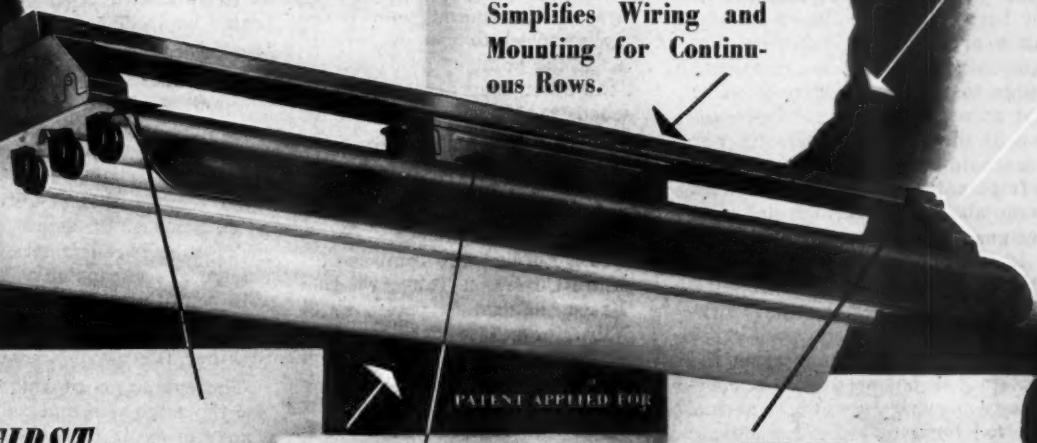
In some types of diaphragm valves, a cooler location is not necessary for the bulb. These valves are designed with the chamber above the diaphragm, very small in volume compared with the bulb. Consequently the bulb temperature will always control the valve. The bulb should be very tightly clamped to the suction line, usually as near to the outlet of the cooling unit as possible. With certain types of

MITCHELITE

SHOWS THE WAY

FIRST with Steel-Saving Design, using a minimum of steel to comply with latest WPB requirements.

FIRST with New-Type "Rigid-Spine" Wireway Channel that Simplifies Wiring and Mounting for Continuous Rows.



FIRST with Simplified End-Piece for Easy Access to Starters and Sockets Without Disturbing Lamps.

FIRST with "Underslung" Ballast located on "Outside" —Cooler operation results in longer life.

FIRST with "Easy-Fit" Coupler for Better, Easier End-to-End Mounting. Simpler—quicker to install.

MITCHELL FLUORESCENT

Get Free MITCHELITE Catalog No. 400 from your MITCHELL DISTRIBUTOR, or write to

4 MITCHELITE Models Answer Every Lighting Need

You can get MITCHELITE lighting in 2-40 watt and 3-40 watt units, 2-100 watt unit, and a 2-section unit for four 100-watt lamps which operates with only one ballast.

Each model is so flexible it can be used for both individual and continuous row lighting—for surface or suspension mounting.

MITCHELL Manufacturing Co. • 2525 North Clybourn Ave., Chicago, Ill.

evaporators, the valve functions better with the bulb along the top of the header.

A frost-proof flare nut should be used to make the outlet tube connection to the cooling unit with any type expansion valve (if a flare joint is used). If it becomes necessary to replace an expansion valve, the liquid outlet valve of the receiver should be closed. The compressor should be operated until the low side pressure is balanced as previously outlined. Valve may then be replaced.

Adjustments on Pressure Type

Most manufacturers of equipment using pressure type expansion valves publish the average suction pressure at which a particular piece of equipment should operate for best efficiency. When adjusting a pressure type valve on this equipment, attach a compound gauge to the suction service valve and adjust until the suction pressure is the prescribed amount. For household refrigerators with SO-2 refrigerant, this pressure varies from about 10" vacuum in some designs up to 0 pressure in others.

If this information is not available for the model under repairs, first set the valve somewhere within the above range and then check for a closer adjustment after the system has balanced and is operating somewhere close to the normal desired temperature. Adjustment should be made so that the frost line stays within the refrigerated space. This check should be made when the system is just about ready to be shut off by the temperature control.

The adjustment is made by turning the adjusting screw (11) in or out, Figures 1 and 2. With most designs the refrigerant flow and suction pressure is lowered by turning the adjusting screw out. The refrigerant flow and suction pressure is raised by turning it in. After adjusting, always replace the bellows case cap. In replacing the cap, leave sufficient air in it so that it does not collapse.

Thermostatic Valve Adjustment

Thermostatic valves are adjusted at the factory to operate with from 8 to 10 degrees of superheat. This setting varies slightly with different manufacturers. With normal average pressure drop through the low side, this setting is usually all right.

In most diaphragm designs, turning the adjusting screw or stem clockwise increases superheat and cuts down the flow of refrigerant. Turning counterclockwise decreases the superheat and increases the flow of refrigerant. On bellows type valves with two bellows, the adjustment is just the reverse. To decrease the superheat and increase refrigerant flow, turn the adjusting screw clockwise. To increase the superheat and decrease refrigerant flow, turn the adjusting screw counterclockwise. With bellows type valves with only one bellows, adjustment is the same as the diaphragm type.

The adjustment of a thermostatic expansion valve can best be checked on the job by the use of two dial thermometers as illustrated in Figure 6. One thermometer is securely attached to the evaporator outlet at the point of bulb location and the other thermometer bulb is attached to the evaporator inlet where the expansion valve is attached to the evaporator.

Assume a Freon-12 system in operation with the thermometer "A" indicating 15 inches. Referring to a Refrigerant Temperature Pressure Coversion Table, we find a Freon saturated pressure of 17.7 lbs. for a 15 degree temperature. This is the pressure that is exerted in the diaphragm chamber of the valve. Now assume that thermometer "B" registers 23 degrees. Disregarding the pressure drop through the evaporator, 23 degrees —15 degrees = 8 degrees superheat at the bulb location. Assuming a 2 lb. pressure drop through the coil between bulbs, this would give a pressure of 17.7—2 = 15.7 lb. at the outlet bulb location. Again consulting the tables, we would find that this pressure corresponds to 12 degrees temperature. We would now have a superheat of 23 degrees —12 degrees = 11 degrees superheat at the bulb location. However, the 17.7 lb. pressure at the coil inlet is the pressure affecting the valve operation and as far as the valve control is concerned we have only 8 degrees superheat controlling the valve.

Expansion Valve Service

Leaking Valve Needle

(A) Pressure Type. This condition usually causes excessive running time with either normal or poor refrigeration. It frequently causes the suction line to frost. To test for a leaking needle, turn out the adjusting screw as far as it will go and run the compressor. If the suction pressure drops below 10" vacuum it is not likely that the valve leaks.

To remedy this condition, try flushing the valve seat. This is accomplished by closing liquid receiver outlet service valve and pumping the charge into the receiver until the compound gauge reads about 20" vacuum. Open the receiver outlet service valve very rapidly and allow liquid to rush by the valve seat. Do this several times. If it does not remedy the condition, replace the expansion valve.

(B) Thermostatic Type. The symptoms and remedy are the same as the pressure type, but the test cannot be used.

Stuck Shut

This condition usually causes no refrigeration with continuous running time in both types of valves. Suction pressure is much lower than normal.

To remedy this condition, first check to see if the strainer is plugged. If it is, clean it and if not, change the expansion valve unless this condition is due to moisture frozen at the needle and seat.

Strainer Dirty

The symptoms of this condition are the same as a stuck shut valve. The remedy is to disassemble the strainer from the valve and thoroughly clean it in a solvent solution then re-assemble.

Charge Lost from Control Bulb

This condition is different with different refrigerants, but results in lower than normal suction pressure with reduced refrigeration or continuous running and no refrigeration. To check for this trouble hold a lighted match under the control bulb. If the charge is not lost, a frosting back and severe hissing at the valve will result.

Remedy is to replace the expansion valve.

Ice On Bellows

Ice around the bellows renders a valve inoperative and it may show symptoms of either a stuck or a stuck shut valve. The remedy is to shut off the condensing unit and allow the ice to melt. Find where the moisture is entering and seal with grease. Sometimes the valve case is cracked then the valve must be replaced.

Government Regulations Affecting the Industry

Ceiling Prices Set On Reconditioned Parts

A ceiling of 75 per cent of the present list prices for new parts or subassemblies was established recently by the Office of Price Administration for reconditioned or rebuilt parts of subassemblies for commercial refrigeration equipment when sold by reconditioners.

The action covers only rebuilt or reconditioned subassemblies and parts which were not sold by the manufacturer during March, 1942. Many manufacturers, OPA pointed out, will be compelled to recondition and rebuild certain part and subassemblies for their own refrigeration equipment because of the tightness in supply of new parts and subassemblies—production of which has been drastically curtailed under War Production Board Limitation orders.

The new ceilings will be under the provisions of the General Maximum Price Regulation. A survey of sales made by OPA of reconditioned parts and subassemblies of several of the large refrigeration equipment manufacturers who during March, 1942, reconditioned and rebuilt parts of their equipment showed that about 85 per cent were sold on the basis of 75 per cent or lower of the list price of an equivalent new part or subassembly.

Reconditioned parts or subassemblies sold by manufacturers during March, 1942, have been and remain under the provisions of the General Maximum Price Regulation at the highest price charged during that month by each manufacturer.

This action was contained in Order No. 555 under the General Maximum Price Regulation, effective June 25, 1943. The order provides that the maximum prices are subject to the same discounts and the same rendition of services which the manufacturer extended on sales of equivalent new parts or subassemblies to the same class of purchaser on March 1, 1942. The measure also defines a reconditioned or rebuilt part and specifies that the ceilings may be charged only if the reconditioned equipment is guaranteed to perform 90 days of satisfactory operation.

Refrigerant Conservation Required by Shortages

The shortage of Freon refrigerant for air-conditioning purposes makes it imperative that theaters, office buildings, hotels, restaurants, and other service institutions equipped with "comfort cooling systems" take immediate steps to conserve their present supply of the refrigerant, the Service Equipment Division of the War Production Board has advised.

A recent amendment to Order M-28 (Chlorinated Hydrocarbon Refrigerants) barred the delivery of Freon refrigerant to any comfort cooling system after June 5. The action was taken to conserve the chemical for essential war industries and for preservation of perishable foods.

This does not mean imminent shut-down of currently operating cooling systems, Division officals pointed out. With proper care and maintenance of existing equipment, the refrigerant can be used for several years without deterioration.

However, to assure continued operation of the equipment, a complete check and necessary repairs should be made without further delay as a precaution against leakage or loss of the refrigerant, officials emphasized. Once present charges of the refrigerant are lost, there will be no possibility of replacing them under present restrictions, it was pointed out. This in effect will force abandonment of the air-conditioning system until Freon is once more available.

Where emergency repairs are necessary, repair and maintenance parts may be obtained through ratings assigned under Controlled Materials Plan Regulation No. 5.

The ban on refrigerants applies only to Freon and does not affect deliveries of carbon dioxide or any other type of refrigerant used in comfort cooling systems.

New Regulations Affect Switchgear

Strict conservation of critical materials and simplification of types in the manufacture of power switchgear and high voltage electric insulators has been ordered by the War Production Board.

Schedule IV will permit an estimated saving of more than 3,000 tons of carbon steel and two million pounds of copper annually in the manufacture of power switchgear. Important steps in the conservation program are:

1. Operating all copper current carrying parts at higher current densities than those previously accepted as standard by the industry.
2. Eliminating many portions of steel enclosures and reducing the gauge of steel in others.
3. Substituting wood or other materials for structural steel in the fabrication of outdoor substation structures.
4. Eliminating duplicate connections, unnecessary hardware and non-essential instruments.

Schedule V is concerned otherwise largely with reducing the number of types of high voltage insulators that may be manufactured. The number of cap and pin type suspension insulators, for example, has been reduced from 44 to eight. Similar reductions have been effected in the number of designs of post type insulators.

One important feature common to both schedules is the elmination of non-essential tests. It is common practice in the industry, it was pointed out by the Office of War Utilities, for producers to make "destruction" tests on equipment of the same type which already has given satisfactory service and for which test data is established. No tests may be made in the future where such information already is available.

Appliance Limitation Order Is Revised

A completely revamped General Limitation Order L-65 (Electric Appliances) was issued recently by the War Production Board, providing for the manufacture of several more kinds of electric appliances for preferred orders, and for a limited production of certain kinds of heavy duty electric appliances for commercial civilian use. The

(*Continued on page 53*)

NEWS of the INDUSTRY
National and Southern

Washer Association Hears Market Expert

Discussing post-war prospects before the meeting of the American Washer and Ironer Manufacturers Association in Chicago, Donald M. Hobart, director of the Commercial Research Division of The Curtis Publishing Company, declared that "the market which is available to the washer industry seems to be substantially larger than the industry has realized."

The evidence is sufficiently clear, he said, "to allow a confident and conservative statement of what the industry could have if it cultivated its markets adequately" and then presented estimates of the annual post-war market possibilities.

Studies made by The Curtis Publishing Company in the various fields of opportunities indicate that annual replacement sales might total 1,500,000 washers; newly electrified farms and farms recently electrified, 250,000; newly established homes, 500,000, and expansion of unsaturated market another 250,000 for a grand total of 2,500,000 units.

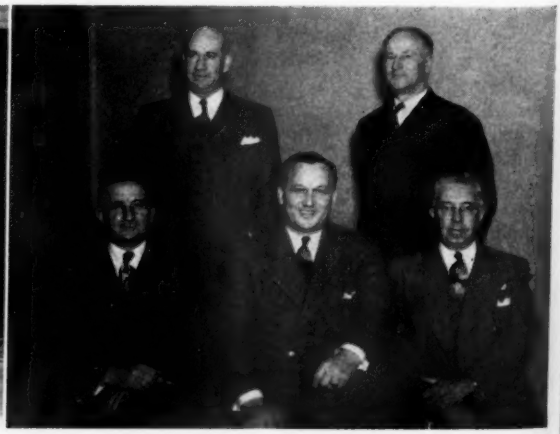
"It will be realized that all of these figures are on the conservative side," the speaker said. "The industry could increase each classification. But the basic question is what proportion of these 2,500,000 sales will be $49.50 conventional washers, and what proportion will be combination washer and ironer sales. It is entirely possible that close to half of these washer sales could be of automatic washers, and it is equally possible that more than a quarter of the total could be combination washer and ironer sales."

Mr. Hobart advised the industry to give serious attention to sales policies, pointing out that "price selling—as the washer industry has seen—leads to unfair methods, destructive to business, destructive to quality of merchandise, and hence, destructive to consumer markets. In price selling the man who can take something out of quality without the consumer detecting it has the advantage."

"Quality selling involves the establishment of brands. In such a market, the man who builds something plus into his product has an advantage, if he can gain recognition for the fact that he has built something extra into his quality. And if he can gain this recognition the consumer has the advantage of assurance of satisfaction."

The conditions which have appeared in need of correction in the industry he listed as: needless multiplicity of brands, a tendency toward price competition, an inadequate cultivation of the market and an inadequate sales job on the consumer who offers to buy.

"The only way the home laundry equipment industry can get rid of the needless multiplicity of local, regional and private washer brands is through the establish-



NEWA WAR CONFERENCE—Record attendance was registered at the meeting of the National Electrical Wholesalers Association held in Buffalo, N. Y., May 23 to 26. The conference was devoted entirely to wartime problems of the industry. At left are shown William L. Batt, vice chairman of WPB, one of the principal speakers; D. Lyle Fife, of Detroit, president of NEWA; Charles G. Pyle, managing director of NEWA; and Harvey Conover, president of Conover Mast Corp., who addressed the group. At right is NEWA's management committee: (seated, left to right) F. R. Eiseman, Revere Electric Supply Co., Chicago; D. Lyle Fife, Fife Electric Supply Co., Detroit; and A. H. Nicholl, president, Graybar Electric Co., Inc. Standing are John L. Bussey, president, General Electric Supply Corp., and John M. Newton, president, Oakes Electric Supply Corp., Holyoke, Mass.

ment of brand leadership of those manufacturers who have been consistently able to produce good quality equipment, who have carried on product research and adapted their merchandise to the needs of the market," Mr. Hobart said.

He pointed out that in this way, by gaining consumer acceptance of new or improved items, there will be little problem of competition from firms having obsolete equipment in the post-war days and no surplus manufacturing capacity available for manufacture of privately branded washers to be sold at a price.

Further, he urged rigorously selective retail distribution which will make possible effective sales effort at the point of purchase, as a remedy for the chaotic market conditions previously prevailing.

"The washer industry has a chance to start anew, to take advantage of its 36 years of experience, and to build the kind of marketing system which will augur greater prosperity for the leaders in this field."

Alabama Dealers Attend Series of Service Schools

A series of two-day service schools for existing and potential service dealers, sponsored by six of the leading distributors of electrical appliance in Alabama, was held during May with encouraging attendance. Manufacturers who had representatives participate in the schools were: Bendix, Crosley, General Electric, Hotpoint, Kelvinator, Norge and Westinghouse.

The idea started last fall when it was realized that with discontinuance of the manufacture of electrical appliances the manufacturers and distributors had an obligation to develop some manner of servicing appliances bought by the public.

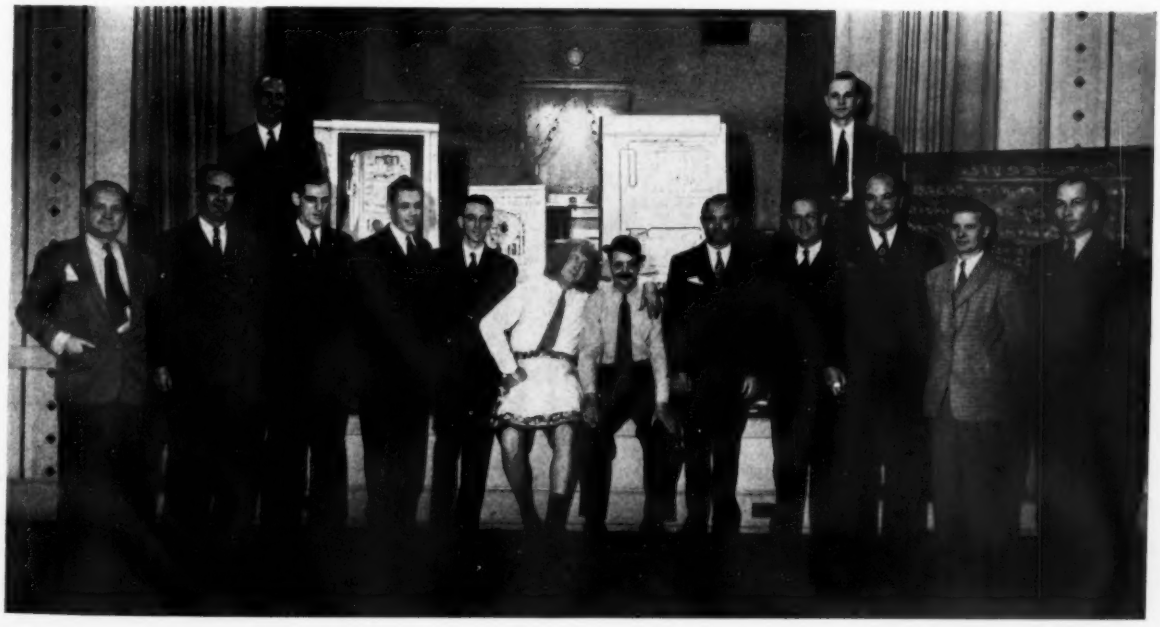
The program was unique in that four different factory representatives, for instance, discussed electric refrigerators. One explained refrigerants and their operating characteristics; another discussed the essential parts of an electric refrigeration system and the cycle of operation; a third outlined common complaints, their causes, testing methods and remedies; and the fourth discussed hermetically sealed units. This was all confined to an electric refrigerator, and covered characteristics, complaints and troubles common to all makes. Name-plates were forgotten and the interchangeability of many parts among several makes of appliances was stressed. These general discussions were then followed by specific discussions of troubles peculiar to individual makes of appliances and by periods of questions and answers on such individual troubles.

To put just a bit of fun in the program and also to demonstrate the necessity of proper customer contact a burlesque skit was put on with A. E. Wood of the Crosley Corporation and Don Swift of the Steel City Supply Company taking the principal parts of service man and customer.

Whole Contracting Firm Leaves for Shipyards

The personnel of the H. C. Hubbard Electric Company, of Lynchburg, Va., has left in a body for Portland, Oregon, to take work in the Kaiser shipyards. H. C. Hubbard, the proprietor, headed the group.

"We'll be back as soon as the



Among the manufacturers' and distributors' representatives who took an active part in the service schools were the following: (reading from left to right, front row) Cal Mitchell, Bendix; Paul Brown, Alabama Power, Anniston; R. H. Shau, Hotpoint; Dean Spencer, Borg-Warner (Norge); W. E. Stuart, Birmingham Electric Battery; Don Swift, Steel City Supply Company and A. E. Wood, Crosley Corporation (both disguised). W. A. Richter, Nash-Kelvinator Sales Corporation; L. S. Hart, Moore & Handley; R. B. Lewis, Westinghouse; K. C. Harville, Matthews Electric Supply Company; Paul Graves, General Electric Company. Back row, left to right: J. R. Lester and E. M. Caller, Alabama Power Company. Present, but not in the picture, was: J. L. Reynolds, representing Graybar.

war is over," he said. He said he had lost seven men to the armed forces and several others had gone to defense jobs. The lack of electrical contracting jobs in the Lynchburg area was the principal reason for leaving, he added.

Wiring Instruction Program Expanded

A new instruction folder has just been published by the National Adequate Wiring Bureau, as a result of suggestions from the field that another piece of simply-worded literature would be a helpful addition to the home wiring maintenance instruction program which the Bureau is sponsoring. "Wartime First Aid for the Home Wiring System" is the title of the six-page folder, which incorporates in its makeup a circuit-survey chart, with clear instructions to the customer on how to determine circuit locations within the home in order to avoid overloading. The back page is devoted to fuse-changing information.

At present, the National Adequate Wiring Bureau's wartime home wiring instruction program is being used by more than 100 electric utilities and electrical leagues or associations, covering a territory serving approximately 14,000,000 wired homes. Plans are being made to expand the program so it can be made easily available to schools and other similar groups that wish to include, in home economics and other courses of study, information on the operation of the home wiring system.

Prices for the instruction folder are one cent each in quantities of less than 5,000; and $8.00 per thousand in lots of 5,000 or more. Order from National Adequate Wiring Bureau, 155 East 44th Street, New York, N. Y.

Overtime Appliance Repair Charge Permitted By OPA

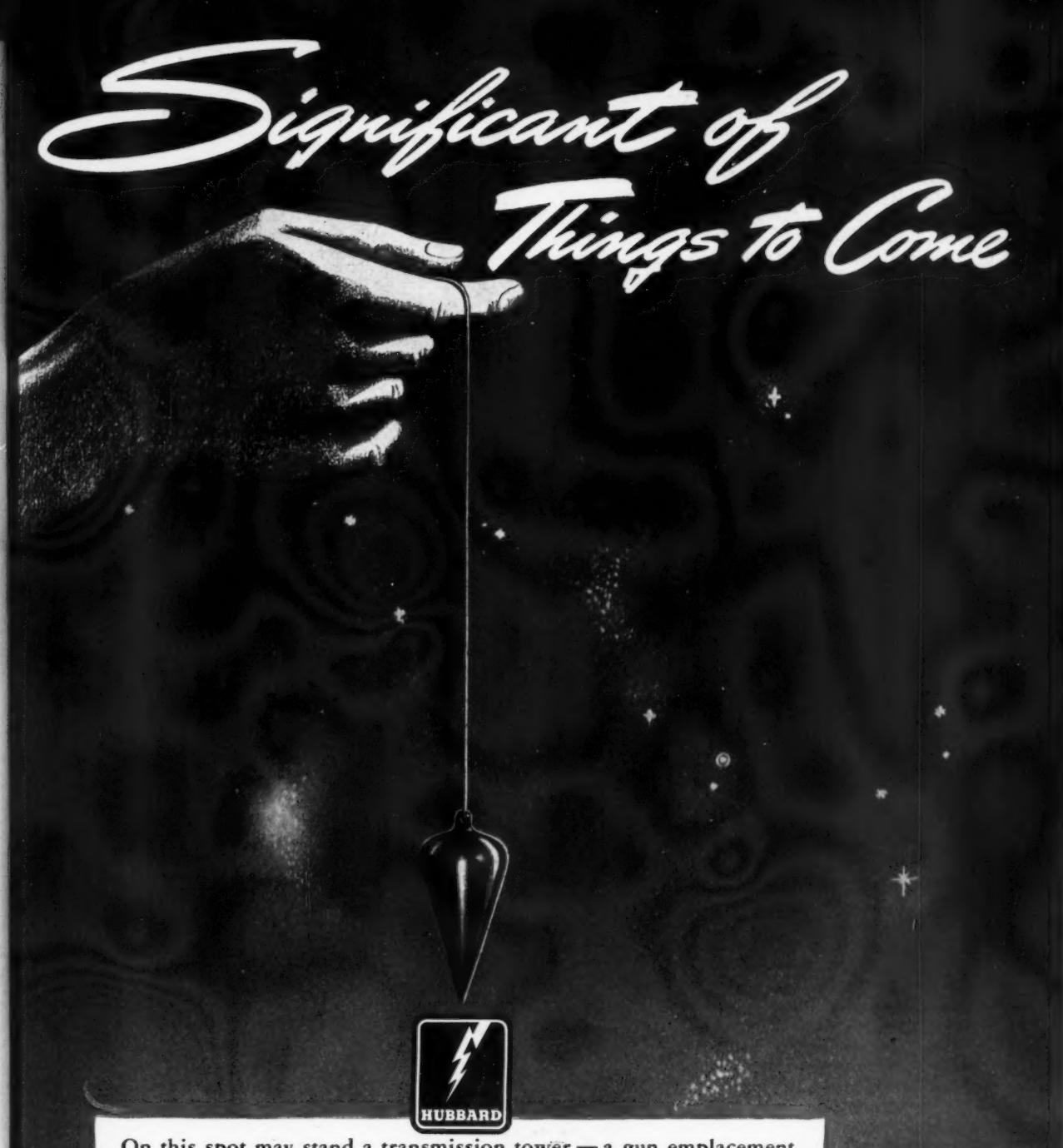
When an appliance repair shop specifically offers to do a repair job in overtime hours, the customer requests such a special service, and the work is actually done during overtime hours by mechanics who are paid time and a half, the repair shop may in most cases charge one and one-half times its regular customers' hourly rate, the Office of Price Administration has just announced.

This interpretation applies where the seller in March, 1942, the base period under the services regulation (Maximum Price Regulation No. 165), actually made an extra charge for overtime labor or where he did not regularly supply any overtime labor as such in March. In the first case, the repair shop has its overtime charge in March as a ceiling price.

WAR STAMPS FOR OLD APPLIANCES — Proctor Electric Company's "War Stamp" Appliance Restoration Program gets the approving scrutiny of Eugene W. Sloan, (right) executive director, War Savings Staff, U. S. Treasury Department. With Mr. Sloan are R. M. Oliver, (left) advertising manager, and R. E. Imhoff (center) vice president, Proctor Electric Company, Philadelphia, originators of the plan. Below, one of the advertisements used to announce the plan.

swap
your old electric appliances
for WAR STAMPS!
AMERICA NEEDS THEM
ELECTRIC SHOP
HELP PROVIDE APPLIANCES FOR WAR WORKERS AND OTHERS!
HUNT THEM WHILE YOU HOUSECLEAN
RUSH THEM TO YOUR ELECTRIC DEALER
DISPLAYING THIS SIGN!
DUQUESNE LIGHT COMPANY
VISIT THE FOLLOWING BEAVER VALLEY ELECTRIC DEALERS TO
SWAP YOUR APPLIANCES FOR WAR STAMPS

Significant of Things to Come



HUBBARD

On this spot may stand a transmission tower — a gun emplacement or new factory. It is the preliminary step to events of the future. It is symbolic of the state in which many of your suppliers find themselves at this time; going over the top on war production but with an eye cocked on the future.

Most of the men and machines of the three Hubbard factories have gone into vital war production, but the plumb bob is swinging, settling down to mark a spot for future development. New designs of Pole Line Hardware are coming. New equipment is being readied to test new principles.

Big things are "in the making". Watch for them, and in the meantime; "Maintain that load on Hubbard Hardware."

HUBBARD AND COMPANY

PITTSBURGH . . . OAKLAND CALIFORNIA . . . CHICAGO

In the second case, where no overtime was regularly supplied in March, the special overtime service now becomes a new or different service, and the maximum price for it is determined either by the nearest competitor's charges or by the use of the regular percentage margin mark-up formula provided by the regulation.

The only case in which the special charge cannot be made is where the repair shop regularly worked overtime in March without any distinction in its charges for regular hours and overtime hours.

In all cases, overtime work at an extra charge must be specifically authorized by the customer, and the extra charge cannot be made merely because employees are worked overtime to finish a job which the customer intended to have completed within regular shop hours.

NASH-KELVINATOR TO BUILD HELICOPTERS—This Sikorsky helicopter, which recently underwent exhaustive United States Army Air Forces tests at Wright Field, is similar to those which will be produced in quantity by the Nash-Kelvinator Corporation, according to an announcement made by G. W. Mason, president. Nash-Kelvinator's production will be made from designs of the Sikorsky Aircraft Division of United Aircraft

Successful Copper Recovery Aids the War Effort

The extent to which the War Production Board's copper recovery program is aiding the Nation's war industries is shown by the fact that to date 197,000,000 pounds of "idle and excessive" copper, both in primary and fabricated forms, have been allocated for war use.

The amount, WPB announced, represents two-thirds of the total amount of copper thus far reported under the program. Of the remaining 100,000,000 pounds reported, approximately 36,000,000 pounds consist of assembled products contaminated with materials not suitable for copper scrap. Arrangements for the movement of the balance are currently being made at Copper Recovery Corporation.

Original estimates were that "idle and excessive" copper to be recovered ranged from 400,000,000 to 500,000,000 pounds. So far, 114,000 firms have been approached in connection with the recovery program and plans are under way to reach 98,000 plumbers, building contractors and their suppliers.

Of the amount thus far allocated, 62,000,000 pounds are in the form of fabricated copper and copper-base alloy. Thirty million pounds have been directed into the regular scrap market, 56,000,000 pounds have been sold for use in present form, and 93,500,000 pounds have been allocated for remelting. The remaining 17,000,000 pounds have been retained by owners for production.

A substantial majority of owners of copper have agreed to sell idle material for remelting for war use at the special Government prices which are well above scrap prices.

Norge Starts Survey of Appliance Market Opinion

A nationwide survey of expert marketing opinion regarding both wartime and postwar activities will be launched immediately by a new organization to be known as the Norge Jury of Marketing Opinion, it was announced by M. Glenn O'Harra, vice-president in charge of sales for Norge Division of the Borg-Warner Corporation.

M. G. O'Harra

Nearly 5,000 appliance dealers throughout the United States, besides more than sixty major distributors in important cities, already are supplying special information in a poll of fact and opinion for monthly findings and reports on the national marketing and economic situation, Mr. O'Harra said.

The survey will seek to obtain particularly data regarding new merchandising and promotional methods, profitable lines for dealers to handle during the war, how manufacturers can help and what they should do to keep dealer organizations intact, product design and functions, public reactions, postwar preparations and other information of vital interest to business and industry, Mr. O'Harra explained.

"This kind of information will be of great value to any manufacturer who is preparing for an era of aggressive competition after the war," Mr. O'Harra continued. "Certainly it will help to keep him in line with the dealers and provide a safeguard against many mistakes which could prove

costly. Our findings each month should no less be of real value to the dealers by helping them to find or increase new profitable operations until peace brings greater trade opportunities."

Mr. O'Harra, who described the plan as an "excellent trade and wartime economic barometer," declared that a growing civilian shortage of electrical refrigerators, ranges, washers and other household appliances is creating a tremendous market for the after-war period and that manufacturers must be prepared to meet it immediately.

"Dealers are insisting that manufacturers get into production of civilian appliances immediately after conversion from war weapons is permitted by official Washington," Mr. O'Harra added. "Post-war models will present some new improvements but no radical changes."

Mr. O'Harra has just returned from a tour of more than 70 cities where company meetings of distributors and dealers were held. The dealers were informed of plans for the "marketing jury" and agreed to make regular reports from their districts.

Victory Lighting for Average Home Owners

"Lighting Enlists for Victory" is the title of a new 35 mm slide film prepared by the Residence Lighting Section of Lighting Research Laboratory of General Electric at Nela Park, Cleveland.

Consisting of 49 "frames," the film is accompanied by a descriptive text which briefly comments on each frame. Authors of the film are Mary Webber and Helen McKinlay, widely known home lighting experts at Nela Park. "Lighting Enlists for Victory" is designed to answer an urgent need for a new educational tool to help the average householder gear homelighting to wartime conditions.

Liberal use of before and after pictures show at a glance how readily more light can be had from existing equipment. Attention is called to greater strains imposed on eyes by increased sewing, mending, kitchen tasks, paper work brought home from the war plant.

Included in the film are pictures contrasting the results of good and bad placement and arrangement of portable lamps. New practical methods for whiting inside surfaces of lamp shades are suggested. White shoe polish, for example, is one of the wartime recommendations illustrated to overcome light loss. Squatty lamps that hide their light under a bushel can be improved by raising them on wood blocks.

Co-starring in the film are the humble dust cloth and wash rag. The film features regular use of soap and water, regular inspections of extension cords and immediate repair when fraying is detected or connection plugs act tired. The film running copy tell just how the homeowner can be his own repair man (or woman) to save eyestrain, time, and vital materials.

"Lighting Enlists for Victory" can be shown in 30 minutes. The film with text may be purchased for five dollars.

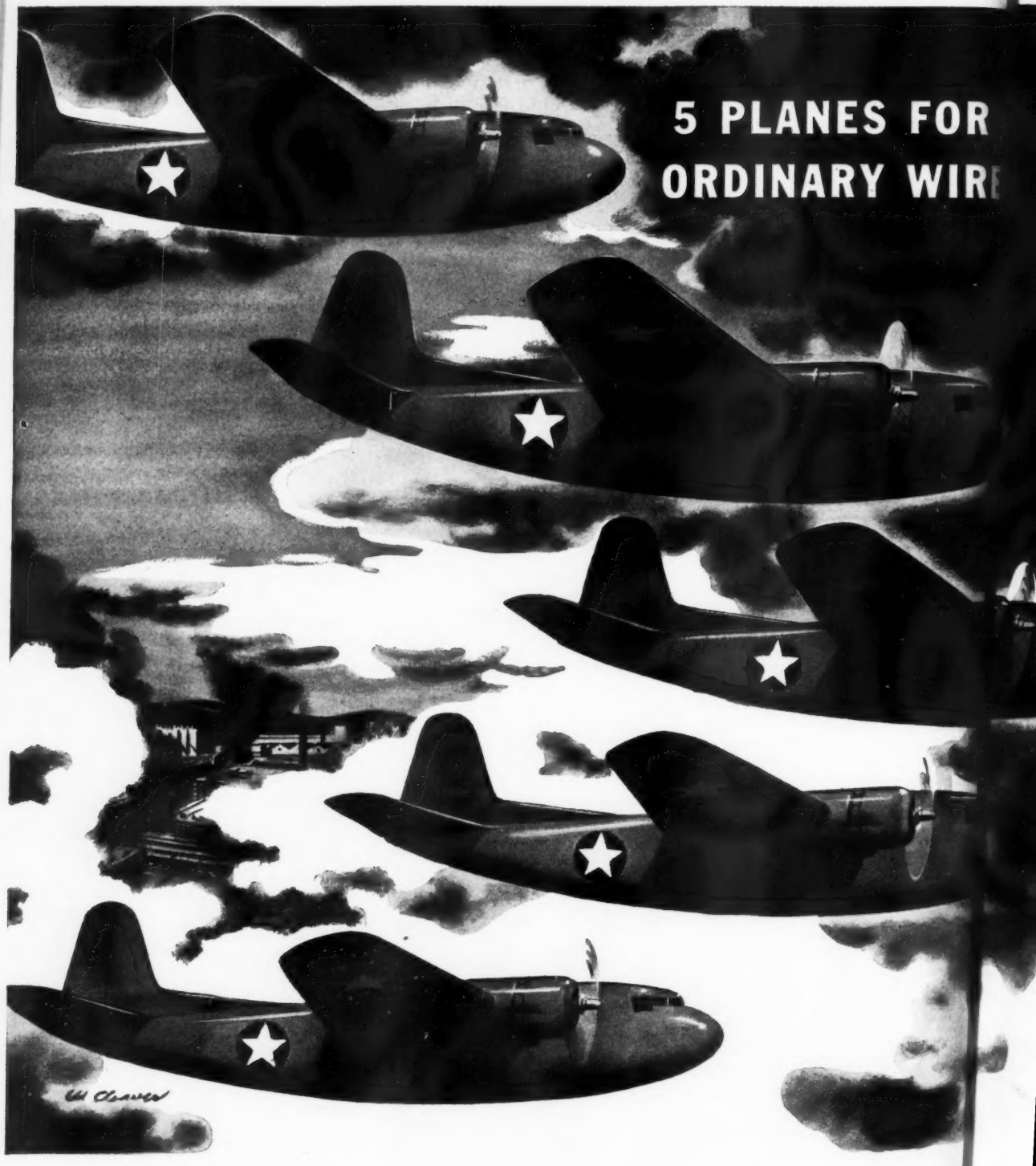
SNAPPED AT THE EEI MEETING—Among the Southerners on hand at the annual meeting of the Edison Electric Institute, early in June, were Louis V. Sutton, president, Carolina Power and Light Co., and his son, Ensign Louis V. Sutton, Jr. Left to right in the picture are Mr. Sutton, C. F. Lloyd, Westinghouse Electric & Mfg. Co., Evelyn Darling, of the EEI staff, Ensign Sutton, and C. E. Stephens, also of Westinghouse.

New Sylvania Industrial Fixture Announced

Sylvania Electric Products, Inc., presents a new industrial type fluorescent lighting fixture which not only incorporates every feature of the present line but includes many features that point the way to future fixture design. It also meets the latest critical material weight requirements of the War Production Board. The first unit designed to operate two or three 40-watt lamps will be shortly followed by a companion unit for a pair of 100-watt fluorescent lamps.

The appearance of the new unit testifies to its streamlined strength which so fully utilizes every ounce of limited critical steel that even the ballast is completely enclosed to contribute to the safety and cleanliness of the unit as a whole. The non-metallic reflector, finished on the outside in industrial French grey to match the top-housing, has a reflecting surface of Sylvania's own Miracoat which makes it even more efficient than its predecessor—porcelain enamel on steel.

The reflector is actually anchored to the top-housing with a pair of "captive latches" which release with a simple quarter-turn, yet lock with a strength sufficient to support more than twenty times the weight called for in service. In application, the unit is most flexible. Chain hanging ears on 43" centers, half-inch knockouts



Listen to the Philharmonic Symphony Program over the CBS network Sunday afternoon 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

*REG. U. S. PATENT OFFICE

UNITED STATES

1 PLANE FOR U. S.
LAYTEX* ASSAULT WIRE

Time is one of our best allies. The faster we can get men and material up to the front, the sooner the war will be won... our fighting men return. That's why transport planes are playing a bigger and bigger part in the Service of Supply... and why Laytex Assault Wire fits ideally into the picture of air transport.

Laytex Assault Wire—made especially for front-line service—requires only 1/5 the space in transport of ordinary communications wire. If Laytex Assault Wire had not been developed and ordinary wire had to be shipped for the same use, by air, four additional planes would be required for transport... planes needed for men, medical supplies, food... whatever must reach the front in a hurry.

Laytex Assault Wire resists concussion and a wide range of temperature changes. It is strong, tough, will not abrade or peel excessively. Laytex is highly flexible. It is waterproof and is closely bonded to accurately-centered electrical conductors. All these qualities are the inevitable result of the unique Laytex Process which applies the compounded, purified insulation in liquid form.

Laytex Assault Wire weighs less than 30 lbs. per mile; has a breaking strength greater than 50 lbs. per conductor; a talking distance of more than five miles.

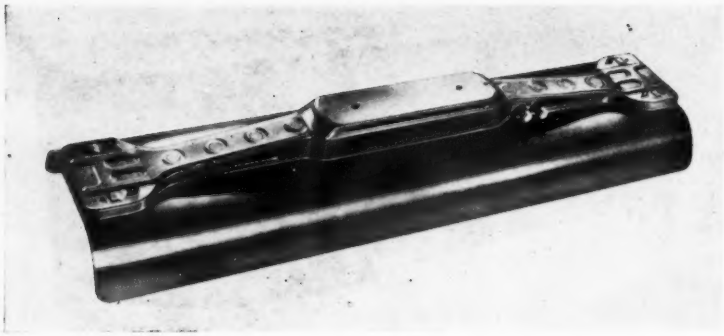
Laytex ASSAULT WIRE

REG. U. S. PAT. OFF

FREES 4 PLANES FOR EMERGENCY TRANSPORT

1230 SIXTH AVENUE — ROCKEFELLER CENTER · NEW YORK

UBBER COMPANY



The new Sylvania industrial type fluorescent fixture.

on 18", 24", 30" and 36" centers, channel for adjustable slide-grip hangers, and knockout for levolier pull chair switch make installation under every condition both speedy and economical. Hanging accessories are available so that any industrial installation problem may be met. Never before has such flexibility been available in a single unit type, since, in addition, easily installed simple joining straps are available for joining a group of the new units into continuous rows of "Fluorescent At Its Finest."

Model HF-100R, using two 40-watt fluorescent lamps has an overall length of 49 3/4 inches, approximate overall width of 13 11/16 inches and overall height of 6 3/4 inches. Weight is 17 pounds. Total wattage including lamps and auxiliaries is 100 watts.

Model HF-150R, with three 40-watt fluorescent lamps has an overall length of 49 3/4 inches, approximate overall width of 13 11/16 inches and overall height of 6 3/4 inches. Weight is 25 pounds. Total wattage including lamps and auxiliaries is 150 watts.

Model HF-235R, using two 100-watt fluorescent lamps has an overall length of 61 1/2 inches, approximate overall width of 16 3/4 inches and overall height of 8 inches. Weight is 31 pounds. Total wattage including lamps and auxiliaries is 235 watts.

All three models are available for 110-125 volts or 220-250 volts, 60 cycle a-c.

All fixtures come complete, ready for installation, including lamps and starters.

Stocking problems for Sylvania distributors are eliminated for, now, instead of a long line of industrial types, a simple stock of basic units plus a reasonable number of joining straps and slide-grip hangers makes any installation immdiately available to the customer with even faster service.

Above all, the new Sylvania unit is not a WPB restricted unit of the present . . . it is the "fluorescent fixture of the future here today."

For further information, write Sylvania Electric Products, Fluorescent Fixture Division, Ipswich, Mass.

Westinghouse Names Planning Committee

Discussion of post-war plans and the development of wartime activities for distributors and retailers are the objectives of a nine-man Planning Committee recently appointed by the Westinghouse Electric Appliance Division at Mansfield, Ohio.

In announcing the formation and aims of the committee, T. J. Newcomb, sales manager of the Division and chairman of the planning group, said such activities as appliance service, nutrition, conservation of materials and consumer education in the care and use of electric appliances will be recommended to Westinghouse distributors and dealers.

Another major objective of the committee is the discussion of broad post-war plans to be developed in detail later. Mr. Newcomb emphasized that in connection with the post-war era the nine-man group was more of a "discussion" than a "planning" committee.

All Westinghouse distributors and retailers are represented on the committee by the six distributor members who serve with three factory executives in charting wartime plans and discussing post-war activities.

These views will be studied at periodic meetings of the committee and plans will be devised to solve problems and put into effect programs and activities recommended by dealers and retailers, Mr. Newcomb explained.

Slogan of the Planning Committee is "Do It Now—For Later." Realizing that the appliance industry is in a position to help the public with such wartime problems as nutrition and keeping appliances in operation, the committee will place stress on activities that can be carried on now, and thus build good will for the future.

These men constitute the Westinghouse Electric Appliance Division's Planning Committee—three factory executives and six distributor representatives—which plans "things to do now" and discusses post-war activities. Standing, left to right, are J. H. Ashbaugh, division manager; W. W. Grant, director of marketing research; E. C. Brauning, vice-president, American Sales Company, Columbus, Ohio; and T. J. Newcomb, division sales manager, Westinghouse Appliance Division; Henry Czech, manager, Westinghouse Electric Supply Company, Chicago, Ill.; H. B. Donley, general appliance manager, Westinghouse Electric Supply Company, New York City; J. S. Shaw, manager, Electrical Department, Moore-Handley Hardware Company, Birmingham, Ala.; E. B. Ingraham, president, Times Appliance Company, Inc., New York City; and T. F. Savage, president, Intermountain Appliance Company, Denver, Colo.

VARNISHED CAMBRIC • RUBBER POWER CABLES • BUILDING WIRE • RADIO WIRES • SIGNAL CABLE • FLEXIBLE CORDS • LEAD ENCASED AND PARKWAY CABLES • ARMORED CABLE

CRESCENT

SHIP CABLES

FOR MARITIME COMMISSION VESSELS AND SMALL BOATS

CRESCENT SYNTHOL (synthetic resin) or Varnished Cambric Insulated Cable is built to Maritime Commission specifications and AIEE Standard 45. It is used for all power, lighting and control circuits on Maritime Commission vessels, and for repairs to commercial craft.

CRESCENT Small Boat Cable employs synthetic resin insulation and jacket with cotton braid or steel wire braid armor. This results in a light, easily installed cable, meeting the requirements of Navy specifications 15C1.

WAR PRODUCTION 100%

CRESCENT INSULATED WIRE & CABLE CO.

CRESCENT
WIRE and CABLE
Factory: TRENTON, N. J.—*Stocks in Principal Cities*

SOUTHERN REPRESENTATIVES

ATLANTA, GA.
Edgar E. Dawes
A-4 Rhodes Bldg. Annex

NEW ORLEANS, LA.
Paul Hogan, Jr.
823 Perdido St.

DALLAS, TEXAS
M. C. Huie
707 Thomas Bldg.

CRESFLEX NON-METALLIC SHEATHED CABLE • SERVICE ENTRANCE CABLE • MAGNET WIRE • BARE WIRE

CRESCENT ENDURITE SUPER-AGING INSULATION • WEATHER-PROOF WIRE

PERSONAL NOTES
About Men You Know

Announcement of the election of **A. M. Wibel** as vice president of Nash-Kelvinator Corporation was made recently by **George W. Mason,** president.

Until recently, Mr. Wibel was vice president and a director of the Ford Motor Co., and his move to Nash-Kelvinator is regarded as significant of the future progress of that corporation in the automotive field. Mr. Wibel joined Ford 31 years ago after two years of pre-law and general college work at Indiana University. He later received a degree from Detroit College of Law and was admitted to the Michigan bar.

A. M. Wibel

Successively, Mr. Wibel was promoted by Ford from engineering clerk to head of engineering purchasing, then in 1927 to director of purchases, and to vice president and director in 1941.

Since 1939, Mr. Wibel has had the added responsibility of all of the company's government sales contracting involving more than $4,000,000,000 worth of war work. He is regarded as one of the few top men responsible for the development of the vast Ford business in the past thirty years.

In announcing Mr. Wibel's election to the Nash-Kelvinator position, Mr. Mason stated that his company's present war contracts and future plans called for the breadth of experience, ability and vision that A. M. Wibel brings to the organization.

* * *

Announcement was made early in June by **George W. Mason,** president of Nash-Kelvinator Corporation of the resignation of **W. F. Armstrong** and **Frank R. Pierce** as vice presidents. Armstrong has been with the company for six years, and Pierce came with the company in 1939.

* * *

Thomas Fuller, southeastern district manager of Westinghouse, has been awarded the Westinghouse Order of Merit by the board of directors of the company, according to announcement by **B. W. Clark,** vice president, at the recent regional meeting of the Atlanta staff.

The Westinghouse Order of Merit is an honorary citation conferred by the action of the board of directors on those members of the Westinghouse personnel who have distinguished themselves by some contribution of extra-ordinary merit in the development of technical progress for industry or for unusually effective efforts that contribute to significant growth or pronounced commercial progress of the company.

Mr. Fuller's citation is in recognition of the energetic leadership that has marked the affairs of the company in the southeast since his appointment as district manager on November 1, 1939. Under his direction the operations of Westinghouse in the southeast have expanded to a place of prominence.

* * *

In preparation for immediate conversion to peacetime production of household appliances as soon as war production conditions permit it, **Paul H. Puffer,** formerly general sales manager of Norge Division of Borg-Warner Corporation, has been appointed to direct post-war planning for Norge appliances, it has been announced by **Howard E. Blood,** president of the company.

Group meetings of company executives will be held at regular intervals to discuss postwar plans for improvements of products as well as aggressive development of domestic and foreign markets, Mr. Blood said.

Paul H. Puffer

Although the company's plants are engaged in large scale production of gun mounts, turrets and other parts and materials for dive bombers, fighting ships and other weapons produced for the Allied Nations, the company's main plant in Muskegon, Michigan, can be quickly reconverted to peace-time production, Mr. Blood added.

* * *

Executive Vice President **C. S. Lynch** of the Arkansas Power and Light Co., was elected president of the Arkansas Utility Association at the closing session of its annual convention in Little Rock. Vice President R. E. Ritchie, of the same company, was re-elected secretary.

About 400 gas and electric company employees and executives attended the convention, voted the finest held since the association was organized.

* * *

M. C. Wilt, executive vice president of Curtis Lighting, Inc., Chicago, has been commissioned a Lieutenant Commander in the Supply Corps, U. S. N. R., and will be on leave of absence from Curtis for the duration. **G. T. Morrow,** vice president in charge of sales since 1940, will assume Mr. Wilt's duties with the title of acting general manager. He will retain his responsibilities as vice president in charge of sales.

Lieutenant Commander Wilt came to Curtis in 1928 as a sales representative for Cleveland, Ohio,

territory. In 1931 he moved to Toronto, Canada, to set up and organize Curtis Lighting of Canada, Ltd., and returned to the United States company as vice president and general manager in 1940. He was also president of Curtis Lighting of Canada, Ltd.

Mr. Morrow has been with the Curtis organization since 1922, first as district representative in Pittsburgh, later as assistant sales manager and general sales manager. He is a graduate of the University of Pittsburgh.

* * *

William B. Gillies, vice president in charge of operations of The Youngstown Sheet and Tube Company and president of the Youngstown, Ohio, Chamber of Commerce, died Sunday, June 20, in the North Side Unit of the Youngstown Hospital after a heart attack. Mr. Gillies was taken to the hospital June 18 after returning from business conferences in New York and Washington.

William B. Gillies

Mr. Gillies was born in Chicago, Illinois, October 6, 1883. He attended Armour Institute, Chicago, and graduated in mechanical engineering from Cornell University in 1904. On September 22, 1909, he married Frances Herrmann and is the father of two sons, William B., Jr., who is associated with the Rust Engineering Company, Pittsburgh, and Lieut. Donald H. Gillies, Fort Knox, Ky.

Mr. Gillies began his career in the steel industry immediately after his graduation from college as foreman for Illinois Steel Company and served in this capacity from 1904 to 1907. From 1907 to 1913 he was superintendent of the Bessemer department at the

doesn't mean *neglect*
...even with Bus Duct

So simple, so sturdy, so soundly engineered is Bus Duct that only a minimum of maintenance is needed. Yet that *minimum* is important.

A thorough inspection and routine service once a year are usually enough to keep Bus Duct at top efficiency. But more frequent attention pays, especially where the system may be subjected to moisture, salt-laden air or corrosive fumes.

Here are some points to watch:

- Keep hanger bolts and bus bar connections tight.
- See that nothing is left in the duct that does not belong there.
- Clean out metallic dust and dirt periodically with an air hose.
- Watch for insulation abrasions on cables.
- Check plugs for loose fuse clips, defective contacts and faulty cable connections.

Maintenance is a real, if unspectacular contribution to the war effort.

Bus Duct can really "take it." Given ordinary, commonsense care, it will keep on delivering power and light under the heaviest loads, at lowest possible maintenance cost.

BUY MORE WAR BONDS • SALVAGE ALL SCRAP METAL

Send for descriptive Bulletin No. 427

BULLDOG
ELECTRIC PRODUCTS CO.
Detroit, Michigan

BullDog Electric Products of Canada, Ltd., Toronto, Ontario

Field Engineering Offices in All Principal Cities

MANUFACTURERS OF Vacu-Break Safety Switches, Saf-T-Fuse Panelboards, Circuit Master Breakers, Switchboards, Bus Duct Systems — FOR LIGHT AND POWER

South Works of the Illinois Steel Company; from 1913 to 1917 he was superintendent of the Bessemer and Rail Mill departments of the same organization; from 1917 to 1921 he was the assistant general superintendent of the Mark Manufacturing Company of Chicago; from 1921 to 1923 he was general superintendent of the Steel and Tube Company of America; from 1923 to 1929 he was district manager of The Youngstown Sheet and Tube Company's Chicago district plants; from 1929 to 1933 he was assistant vice-president in charge of operations of The Youngstown Sheet and Tube Company and was located in Youngstown; from 1933 until his death he was vice-president in charge of operations.

* * *

Herbert R. Owen, vice-president and manager of the New York office of Landers, Frary & Clark, died May 22 at his home in New Rochelle, N. Y., after a short illness. He was 53 years of age.

Herbert R. Owen

Before his association with Landers, Frary & Clark, Mr. Owen was sales manager of the New York division of the Cleveland Metal Products Co. After joining Landers, Frary & Clark, he became sales manager of the Department Store division in June, 1923. He was elected a vice president of Landers, Frary & Clark in March, 1926, and assumed charge of the New York office in July, 1936.

* * *

Otto A. Frederickson, commercial engineer of the National Electric Products Corp., Pittsburgh, Pa., died on Saturday, June 5. Mr. Frederickson was a member of the International Association of Electrical Inspectors and participated in the programs of many of the IAEI chapter and section meetings.

Fluorescent Inspection Light

Designed to meet new requirements of inspection notably in war industries, Commercial Reflector and Manufacturing Company, Los Angeles, Calif., has just introduced a new fluorescent inspection light.

Adapting the streamlined shape of the fluorescent lamp together with the unbreakable safety features of plastic Lucite, Commercialite's new portable light meets inspection problems arising from inaccessible places in aircraft, ships, war tanks and many other types of industrial applications, including automobiles, boilers, heavy machinery.

Sturdy and simple in construction the light is easily taken apart for lamp replacement by removing two screws. Combination metal light baffle and support shields light from inspector's eyes. Standard cord plug and ballast box with 20 ft. of cord complete the equipment. Write for bulletin.

FORESTALL *electrical breakdowns...*

...with the **"MEGGER"** tester!

AS RECENTLY ANNOUNCED, *we are now building "Megger" instruments in this country, and are in production on the popular "Meg" and "Super-Meg" types. The acceptance accorded these new all-U. S.-made instruments has added to our already large backlog of orders, which we are now filling as rapidly as possible. Your orders for "Megger" instruments will be accepted according to priority ratings and with our assurance that delivery will follow as quickly as our further-expanding facilities will permit.*

Now, more than ever, it is vital to hold electrical failures to a minimum. Periodic testing of the insulation of motors, generators, cables, signal-control and other electrical apparatus can save priceless time and protect irreplaceable equipment. Testing with a "Megger" instrument is only a matter of minutes, but it can reveal potential damage and save days of costly delay.

"Megger" insulation testers are completely self-contained—wholly independent of batteries. Simply connect to the equipment under test, turn the hand cranked generator and read insulation resistance directly by the pointer over the scale. Over 40 years of service in industry has proved the value of "Megger" Practice.

Write for any or all of the bulletins listed and a free copy of the Pocket Manual of "Megger" Practice, No. 1420-O.

BIDDLE BULLETINS

- Use of Hand-driven "Megger" Testers, Bulletin 1655-O.
- How to Test Insulation and Avoid Trouble in Electrical Equipment, Bulletin 1640-O.
- Various types of "Megger" Insulation Testers, Catalog 1685-O.
- Bulletin 1735-O on the New U. S.-made "Megger" Insulation Tester in plastic molded case.

JAMES G. BIDDLE CO. • **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

Demand for FRIGIDAIRE Wartime Suggestions booklet passes the 5 million mark!

"Public anxious for this kind of information"

"600 requests from one radio announcement"

"Entire supply of booklets exhausted in two days"

"Gave away 1300 booklets Saturday"

"Building more genuine customer appreciation than anything we have had in 18 years"

THESE typical field reports give you an idea of the extraordinary dealer and public interest in the Frigidaire campaign. The entire program is a tremendous success!

Dealers are enthusiastic as they witness public reaction to national advertising and local promotions built around the WARTIME SUGGESTIONS Booklet. All types of dealers from all parts of the country are writing in to tell how they are capitalizing on this real opportunity to build good will in their communities by rendering a genuinely helpful service to present and potential customers.

To date public and dealer demands for WARTIME SUGGESTIONS Booklets have exceeded 5 million copies, and this figure is steadily growing as an ever increasing number of dealer activities get under way.

Here's a campaign that speaks the dealer's language

. . . for it talks about refrigeration — the dealer's business. The above ad, 5th in a series, will appear in full color during July and August in Life, Ladies' Home Journal, Woman's Home Companion, Good Housekeeping, and McCall's, and in 2 colors in Better Homes & Gardens, American Home, True Story, and Farm Journal and Farmer's Wife.

For Excellence ARMY E NAVY *in War Production*

FRIGIDAIRE Division of GENERAL MOTORS

Peacetime builders of Home Appliances, Commercial Refrigeration, Air Conditioners

NEW EQUIPMENT and MATERIALS

Ampac "200" Welder

An important new forward step in alternating current welding in the form of its new Ampac "200" welder has just been announced by the Allis-Chalmers Mfg. Co., Milwaukee, Wisconsin. Added to many advantages of a-c over d-c welding pointed out by the company, a number of distinctive features are also claimed for the new Ampac to establish it as an important factor in the rapidly growing trend to a-c welding in the nation's war industries.

Described as the welder with the ideal operating curves, the Ampac "200" automatically gives the operator correct voltage for the continuous range of currents available, rather than using an almost constant voltage to all current settings. This adjustment not only makes welding easy at low currents because of the high striking voltage, but saves power when welding at high currents because the voltage is low.

Other special design and operating features of the Ampac "200" include the new integrated reactor-transformer construction which provides the high, yet safe voltage for easy welding at low currents; active duty from every line of flux . . . assured by reactor coils which surround the variable air gap; and simplified construction using fewer working parts, cutting maintenance down to routine lubrication twice a year.

Booklet on Mot-O-Trol

Mot-O-Trol, an electronic adjustable-speed drive which provides wide stepless range, automatic speed regulation and smooth, fast acceleration with automatic current limitation, is described in a new booklet announced by Westinghouse Electric and Manufacturing Company.

The new 4-page illustrated booklet tells how the Mot-O-Trol works, and lists its advantages. Charts show motor speed characteristics for a 20 to 1 speed range, 10 to 1 speed range, and constant speed. In the new drive, incoming a-c power is converted to direct current by thyratron tubes, which supply the direct current to armature and field circuits of the d-c driving motor. A potentiometer in the control station varies the voltage of the current by shifting the phase of the grid control voltage of the thyratrons. Both armature and field circuits are controlled by one dial on the control station. Also pictured is a Mot-O-Trol control station with two dials, for applications requiring forward and reverse speed.

Other features of the Mot-O-Trol listed and discussed in the booklet are its fewer rotating parts—minimum vibration—stable operation with full torque at low speeds; ease of mounting; constant torque—zero to base motor speed; and finger tip speed control.

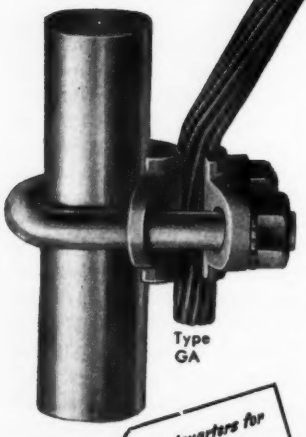
A copy of booklet B3256 may be secured from Department 7-N-20, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

Waterproof Shipboard Cable

As an alternate to its basketweave wire-armored shipboard cable, the Hazard Insulated Wire Works Division of the Okonite Company, manufacturers of insulated electrical cables and wires of all kinds, Wilkes-Barre, Pa., announces Loxsteel, a new waterproof shipboard cable. The new cable differs from previous designs only in the armor covering. It is available, of course, subject to federal limitations and restrictions.

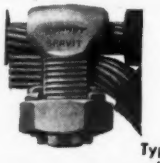
Loxsteel has a full interlocking metallic tape armor with smooth inner and outer surfaces and rounded arch. Loxsteel Shipboard Cable has a double-packed seal, designed to prevent moisture from entering the metal tape armor or junction boxes. This is an exclusive feature of Loxsteel and its watertightness has been confirmed by severe tests conducted

Sure Ground



Burndy Ground Connectors afford reliable, *low resistance* ground connections, with *high resistance* to underground corrosion. All parts are designed for ample strength, and each Burndy Ground Connector is *engineered* for its own specific job.

And that's true of all Burndy Connectors. Take the Burndy Servit, for example. This compact service connector gives some 50% greater pressure on the conductors – thanks to a design which wastes less torque in overcoming thread friction. Each size accommodates a large range of conductors and can be used over and over again. Bulletin on request.



Headquarters for Connectors

Burndy GROUND CONNECTORS
BURNDY ENGINEERING CO., INC.
107 EASTERN BLVD., NEW YORK CITY

by the National Bureau of Standards. One of these tests consisted of connecting a section of Loxsteel into a junction box through a regular marine-type packed fitting and completely submerging the assembly. After three weeks of submersion, the Bureau took apart the assembly and then the cable itself and no evidence of water leaking under the cable armor was found, nor was any water found to have entered the junction box at any time.

Another shop test consisted of inserting a section of lead-sheathed Loxsteel into a cylinder using standard fittings for the outlets. No leakage occurred even after hydraulic pressure of 200 pounds was applied for 36 hours. A section of Loxsteel cable **without** a lead sheath withstood exactly the same amount of pressure for the same length of time.

Loxsteel Shipboard Cable is flexible and can be bent without injury around a circle only six times the cable diameter. It is a patented cable manufactured under "Spiralok" patents.

Specifications: Conductors, insulations, tapes and lead sheath are made in strict accordance with A.I.E.E. Spec. 45, 1942. Revision. Standard marine fittings can be used.

Conductors: All sizes and required numbers.

Insulation: Rubber, synthetic resin or varnished cambric.

Sheath: With or without lead sheath.

Armor: Galvanized steel with chromate coating.

Voltage: As required.

Diameter: Within A.I.E.E. specification limits, Loxsteel can be installed in standard fittings.

Weight: Average not more than 5 per cent over nominal weight listed in specifications.

Loxsteel is approved by U.S. Army, U.S. Maritime Commission, American Bureau of Shipping, Bureau of Marine Inspection & Navigation, and various U.S. Naval Districts.

Insulating Varnish

The Sterling Varnish Company, Haysville, (suburban Pittsburgh) Pennsylvania, has issued Bulletin 143 entitled "Thermobonds, the New Insulation."

The bulletin describes ten insulating mediums that have been thoroughly tested in the applications for which they have been produced by subjecting them to excessive heat, heavy overloads, and atmospheres crowded with acid or alkali fumes and abrasive materials. The Thermobonds are produced for application to such units as high speed armatures, high cycle drill and grinder motors, heavy duty motors and transformers, and marine engine magneto coils.

Copies of this new literature are available on request.

RE-LIGHTING
the new manpower / production *requirement*

HERE'S ONE ANSWER
to this problem...

This new folder tells the whole story. Send for it!

Because most plants operating today were designed for peacetime, *daylight* working schedules, *their lighting equipment is inadequate for night work!*

The folder illustrated gives one answer to industry's problem of *re-lighting*. Silv-A-King's new fluorescent reflectors of non-critical, metal-saving Silv-A-Tex are durable, efficient, inexpensive, and available for prompt delivery. For complete descriptions and specifications of Silv-A-King "Victory" units, write for a copy of "Catalog 43-V" today!

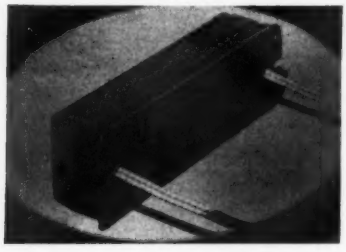
SILV-A-KING
MAKES *Light* WORK FOR YOU

BRIGHT LIGHT REFLECTOR COMPANY, INC.
310 Morgan Avenue, Brooklyn, N. Y.

BROILKING AFTER THE WAR, MORE THAN EVER *America's Finest Electric Table Broiler*
INTERNATIONAL APPLIANCE CORPORATION
1027 Metropolitan Avenue, Brooklyn, N. Y.

Bottom-Lead Ballast Units

Designed as an aid to fixture manufacturers in their programs to save critical materials, a new line of ballasts with leads coming out through two bushed holes at each end of the base plate is announced by General Electric. Bottom location of the leads is the only difference between the new units and the Company's conventional ballasts, but that one feature can save pounds of critical materials per fluorescent fixture.



Installation of the bottom-lead ballasts is simpler, because they can be mounted completely exposed atop a narrow, shallow wiring channel just wide and deep enough to enclose the leads. Since this obviates the need to allow room for the complete ballast in the fixture proper, substantial savings in iron and steel are possible. Moreover, because of their exposed location, the new ballasts will operate in lower ambient temperatures, which contributes to long ballast life. They do not require special installation features, such as ventilating louvers and conduction plates.

The bottom-lead ballasts are available in the ratings most commonly used in war plants: 40-watt Tulamp and three-lamp ratings, and 100-watt Tulamp and Forlamp ratings. Full information on the complete line of G-E ballasts for fluorescent lighting is contained in Bulletin GEA-3293, available on request from the General Electric Company at Schenectady, N. Y.

Brazing With Phos-Copper

How to braze with Phos-Copper, brazing alloy which saves time, machines and manpower and can be used with gas, incandescent carbon, electric furnace and dip brazing methods is discussed in a new booklet announced by Westinghouse Electric and Manufacturing Company.

The new 12-page booklet contains hints on good brazing and proper joint designs. Butt, scarf, shear and lap joints are considered, and diagrams show proper designs.

Phos-Copper is free-flowing at 1382°F., so heating time is shortened. Machining of the finished joint is not necessary in most cases. Among the advantages of Phos-Copper listed in the booklet are its low melting point, uniformity of brazing material, high tensile strength and stress cycle, 98 per cent electrical conductivity of joint. It resists corrosion, can be tinned or electric-plated.

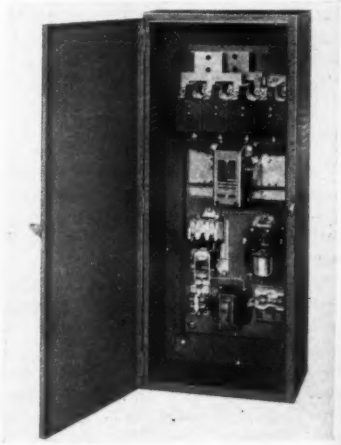
A copy of booklet B-3201 may be secured from Department 7-N-20, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., or from the nearest Westinghouse office.

Safety Control for Welders

Newly developed safety panels, just announced by the Industrial Controller Division of the Square D Company, Milwaukee, eliminate the hazard created by high open circuit voltages of transformer type a-c arc welders.

It is known that physical contact from electrode to grounded metal surfaces, when not welding, can sometimes result in operator injury. These new class 8992 panels eliminate this hazard by automatically disconnecting the welder transformer after the arc is broken. The transformer is automatically reconnected the instant the operator touches the electrode to the work. Thus, the arc is struck with no delay. There is no loss in operating speed or efficiency.

The manufacturer stresses an economy angle, too. When Square D safety panels are used, the welding transformer primary circuit is connected to the power line only while the arc is held. Substantial saving in power is effected when a number of welders are used on a single power system and the power factor is improved.

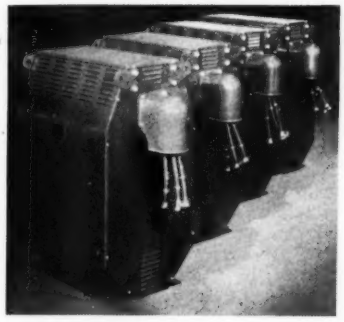


These new safety panels can be used with any make or model of a-c transformer type arc welder. External connections are simple and internal connections of the welder need not be disturbed.

REVIVE sick ranges with
CHROMALOX
HEATFLO
These units fit all electric ranges. They cook the modern way—with black heat. Their flat top transmits heat by contact — the fastest, most economical way. They are most easily cleaned. All users like them. Write for details.
ATLANTA, GA.—C. B. Rogers, 1000 Peachtree St. DALLAS, Texas—L. R. Ward, 403 Southland Building Annex. RALEIGH, N. C.—W. R. Phillips.
EDWIN L. WIEGAND COMPANY, 7600 THOMAS BLVD., PITTSBURGH, PA.

New Dry-Type Transformers

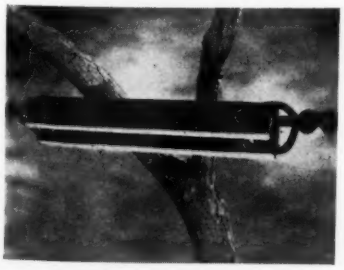
A new series of dry-type natural-draft transformers, announced by General Electric for indoor use on 600 volts and below, incorporate a number of improved design features. As compared with the series they supersede, size and weight of the new transformers have been materially reduced, permitting lighter foundations and requiring less floor space. Ventilation has been made more effective by slanting louvered side plates inward at the bottom and top of the case. This permits a directed flow of air through the case vertically, entering at the bottom, passing through the coil ducts, and out through the top louvers with little change in direction.



The new transformer has a two-legged core with a high-voltage coil and a low-voltage coil on each leg. The core is clamped at its top and bottom, with the bottom clamps also serving as mounting feet. Used thus, they provide a base, being drilled so that the transformer may be bolted to the mounting surface if desired. The top clamps are used for lifting the transformer, and also serve as the upper bracket, if the transformer is wall mounted. Because of the unusual case design, the unit can be mounted against a wall or close to other units with little or no effect on temperature rise.

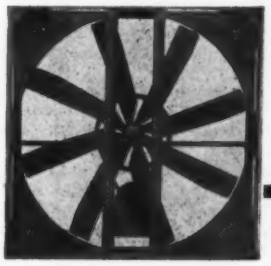
Pinco Tree Insulator

The Porcelain Insulator Corporation, of Lima, N. Y., has just placed on the market a new all-porcelain tree insulator designed as a replacement for wood tree wire protectors, tree wire and tree-anchored insula-



This New Regulation Increases

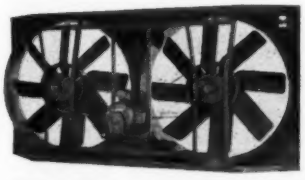
SALES OPPORTUNITIES for Coolair TRADE MARK Exhaust FANS and BLOWERS in YOUR territory!



UNDER CMP REGULATION 5 which permits minor capital expenditures on additional equipment and plant improvement, hundreds of manufacturing and processing firms in your territory can now assign their own priority rating to orders for Coolair Fans . . . to properly ventilate and lower temperatures in workrooms and processing spaces in their plants.

Contact the right men in these plants and sell them on Coolair Breeze-Conditioning as the simple and economical way to maintain high employee efficiency during the hot summer months and at the same time help reduce absenteeism by improving working conditions.

If you find that their needs exceed the limit of expenditure authorized by this regulation, help them prepare and file application on Form PD-1A with your nearest WPB Field Office for quick action.



TWIN UNIT FAN: Widely used where limited headroom or vertical wall space does not permit use of adequate sized single unit Coolair Fan.

PROMPT SHIPMENT . . . can be made on many types and sizes of Coolair Fans on orders bearing a rating of AA-5 or better.

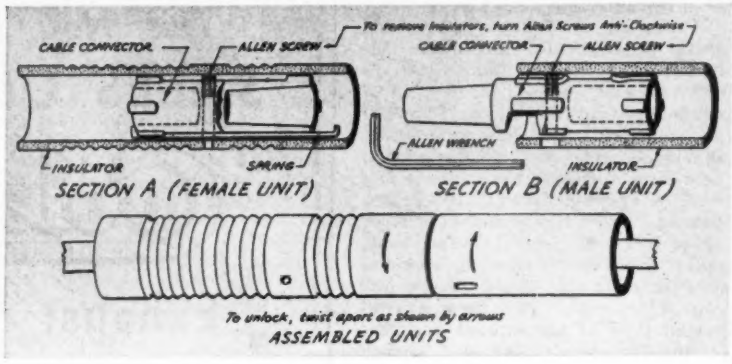
Call on us if we can be of help in working out difficult problems in ventilating and lowering summer temperatures.

A full description of the Coolair line, with tables showing models, dimensions, performance data, etc., can be found in
SWEET'S CATALOG A.S.H.V.E. GUIDE
ELECTRICAL BUYER'S REFERENCE

AMERICAN COOLAIR CORPORATION
3604 Mayflower Street Jacksonville, Florida

tors. It is made of Pinco High Test Porcelain, glazed, and has an extremely hard and smooth surface to take care of the abrasive action of the tree or branch. It is also of sufficient length (12, 14 or 16 inches long), to take care of any contact required and even in multiple installations is not too heavy for use on any span. Easy to install, the insulator is hung on the wire at the point of contact with tree or limb, and the tie wires threaded through the two holes at each end of the insulator and twisted about the service wire, thus holding it securely in place.

These insulators were developed to meet a demand of utility operating engineers for a permanent method of insulation that could be depended upon at all times to prevent energized wires from grounding on tree trunks or large branches.



Welding Cable Connector

A new cable connector that locks tight, quickly unlocks and is fully insulated has recently been developed for arc welding.

Female section is soldered to cable lead. Male section is soldered to cable extension. Removable insulators are securely held in position with Allen screws. Connection is made by inserting male section into female section. Thus, with a twist, the locking spring rides the cam into position holding both sections tight. To unlock, simply twist apart.

This connector, known as the "Quik-Trik," is manufactured by Jackson Products, Detroit, 7, Mich.

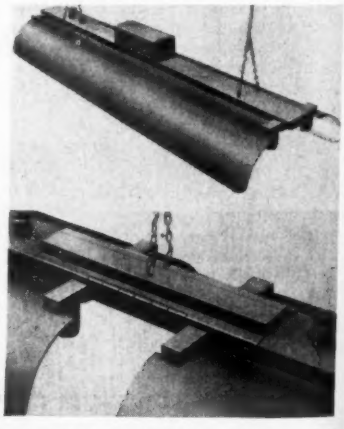
The female section, when installed on a cable lead, may also be used as a holder handle and connected directly to the "Stinger" end of a Jackson Model TA holder. This adaptation saves time, material, eliminates the danger of live cable ends and makes possible the economies of standardization.

Distribution Panelboards

Square D Company, 6060 Rivard Street, Detroit, Michigan, have just revised their Bulletin 2500 covering Saflex Power Distribution Panelboards. Copies are available on request. Saflex panelboards are designed to meet the rigid requirement of wartime industry for such equipment employing interechangeable switch units. They are dead front and are approved by the Underwriters' Laboratories, Inc. Saflex panelboards in standard and modified forms are being extensively used by the United States Armed Forces.

Industrial Fluorescent Units

Martin-Gibson Company, illuminating engineers and equipment manufacturers, 999 Harper Avenue, Detroit, has just announced its new "5,000 Line" of industrial fluorescent lighting fixtures. Conspicuous feature of this new streamlined line is the "Flexi-Coupler," a device which permits spacing of fixture units as much as six inches apart, yet preserves all the features of a continuous-run installation. This makes possible, for example, the use of only nine 100-watt fixtures in a 50-foot run instead of ten, saving current and cost. The 5,000-Line has the new lightweight channels, conforming to new government conservation order.



You Conserve Critical Steel When You Use BRIEGEL FITTINGS

In every Briegel fitting there's a saving of 25% on steel over any other fittings on the market. For use on interior jobs they're approved.

(*And*, incidentally, there's a *25%* saving of TIME, too, when you use B-M fittings!)

DISTRIBUTED BY

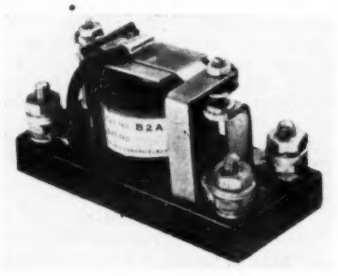
The M. B. Austin Co. Chicago, Ill.
Clayton Mark & Co. Evanston, Ill.
Clifton Conduit Co. Jersey City, N. J.
General Electric Co. Bridgeport, Conn.
The Steelduct Co. Youngstown, Ohio
Enameled Metals Pittsburgh, Pa.
National Enameling & Mfg. Co. Pittsburgh, Pa.
Triangle Conduit & Cable Co. New Brunswick, N. J.

BRIEGEL METHOD TOOL CO., Galva, Ill.

Non-metallic reflectors attain an unusually high reflection factor of 89 per cent to 91 per cent, due to M-G's "Permaline" method of enamelling. Available in two 40-watt, three 40-watt and two 100-watt sizes starting July 1st.

Ward Leonard Relay

Ward Leonard Bulletin 103 Relay is designed particularly for aircraft power circuits. It will perform at high values of acceleration of gravity and also under conditions of vibration and shock. The armature and contact assembly are designed to retain either position under these conditions.



The normally-open, single pole contacts are rated 25 amperes at 24 volts d-c non-inductive load, with good characteristics on inductive loads. The contact gap and tail spring tension are adjustable.

Molded Bakelite nearly 3/8 inch thick forms the base measuring 1 3/8 x 3 1/8 inches. Two holes are provided in the base for mounting. Complete data is contained in Bulletin 103—available on request.

A-C Motor Starters

The Type H motor starter, a new addition to their industrial control line built especially to withstand severest wartime operating conditions, was announced recently by the Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin. Designed for low first cost, the new starter is a metal-enclosed structure similar to metal-clad switchgear. High interrupting capacity, disconnecting-type fuses are utilized in combination with a heavy duty oil switch in the new starter.

Type H starters have been developed for both induction and synchronous-type motors rated up to 1,000 hp at 2,300 volts and 1,750 hp at 4,600 volts, three-phase, 60 or 50 cycles. Their usages cover: full or reduced voltage starting, dynamic braking, reversing and special applications.

Short circuit protection up to 160,000 kva at 2,300 volts and 320,000 kva at 4,600 volts eliminates the need for a back-up breaker with-

FOR LONGER LAMP LIFE and INCREASED LIGHT OUTPUT*

CUSTOM and Precision BUILT BALLASTS

THOROUGHLY TESTED SUPERIOR THOROUGHLY PROVEN

Superior Custom and Precision Built Ballasts for stock items are giving users approximately 25% *additional lamp life* and *increased light output* by retarding the blackening of the lamp ends. The successful operation of Superior Ballasts is due to exclusive patented features developed to overcome the common faults of competitive ballasts of similar design. The entire ballast-manufacturing process is under one roof—in Superior's new Chicago plant...and there is a Superior Ballast to fit every type of fluorescent unit.

A few users:
Mitchell Mfg. Co.
Westinghouse Elec. Supply Co.
General Electric Supply Corp.
Graybar Electric Company, Inc.
Ruby Lighting Co.
Progress Mfg. Co.
Electro Mfg. Co.
Lighting Products Corp.
American Fluorescent Co.
L. J. Segil & Co.
Solar Lighting Co.
Van Dyke Industries

* EXPERIMENTAL LABORATORIES where temperature runs and WAVE-FORM ANALYSIS are thoroughly made. Here Superior products are designed, tested and proven under actual operating conditions.

A Superior oscilloscope wave-form showing true power saving wave-form produced by Superior's exclusive patented feature of design.

B Competitive oscilloscope wave-form produced by competitive ballasts of similar design. This demonstrates approximate 25% loss of power and light output resulting in blackening of lamp ends and shortening of lamp life.

WRITE FOR NEW DESCRIPTIVE CIRCULAR

SUPERIOR ELECTRICAL INDUSTRIES

FLUOR-O-CONTROL, QUALITY CONDENSERS, ELECTRICAL TRANSFORMERS AND SOLENOID WINDINGS OF ALL TYPES

DEPT. F — 2614 W. NORTH AVE., CHICAGO, ILLINOIS

in these kva ratings. Disconnecting type fuses combining high interrupting capacity with fast-clearing action, hold short circuit currents to safe values which do not damage the control. Fuses operate only under actual short circuit conditions and will not blow unnecessarily.

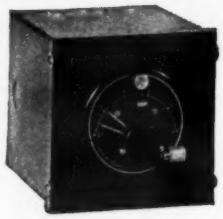
The new Type H starters protect motors from sustained overloads, locked rotor condition, single phasing and overloading caused by too frequent starting by means of termal overload relay accurately calibrated.

New Cramer Reset Timers

The new RS4 and RS5 synchronous motor driven timers are of the reset type and are now available for time ranges up to five hours and longer if desired, according to announcement by R. W. Cramer Co., Inc., Centerbrook, Conn.

These new timers have a wide application for accurately timing any electrical circuits, such as the automatic timing of machinery operations, chemical and food processing or heating processes.

These timers repeat their time cycle under manual operation of a built-in start button and they indicate at a glance, by means of a progress indicator which moves toward the zero mark of the scale when



RS5-M5

Cramer Automatic Reset Timers

RS4-M5

in operation, the expired and unexpired time cycle as well as the setting time.

The RS4 timer has a double throw switch and opens or closes the circuit, depending upon the choice of circuit, and starts by pressing and then releasing the start button, which also resets the timer. The RS5 is different in that it is mechanically held in a neutral position when the button is depressed, and it starts the timing cycle by pulling the start button outwardly.

These timers operate a single pole double throw switch with a capacity of 10 amperes at 115 volts or 5 amperes at 220 volts a-c non-inductive load, and will control a 1/3 hp motor load, a heater load of up to 1200 watts, a lamp load of up to 250 watts or a relay load which does not exceed 15 amperes inrush at 115 volts a-c.

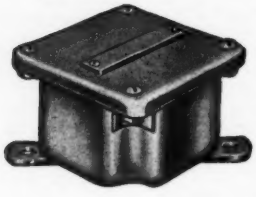
Expanded Range Oscillograph

Critical wartime requirements are responsible for a new cathode-ray oscillograph characterized essentially by a greatly extended frequency range, more versatility in the handling of applied signals, and special pickup means whereby input capacitance is reduced and stray pickup eliminated. Removable front cover protects panel, controls and tube screen, and also holds the shielded-cable test probe, when instrument is not in use.

Known as Du Mont Type 224, this new oscillograph is now offered as a standard instrument by Allen B. Du Mont Laboratories, Inc., Passaic, N. J. One of its outstanding features is the Y-axis or vertical deflection response which is uniform from 20 c.p.s. to 2 million cycles. It has a comparably faithful square and sinusoidal wave response. The X-axis or horizontal deflection amplifier has a uniform characteristic from 10 c.p.s. to 100 kilocycles. Both amplifiers have distortionless input attenuators and gain controls.

The widest variety of signal input connections are available. In addition to the conventional amplifier connections, signals can be applied directly to the deflection plates of the 3-inch cathode-ray tube, when it is desirable, by means of terminals at the front panel of the unit.

Spero *now offers prompt delivery on Navy 9-S Fittings & Fixtures*



The following numbers in the 9-S series of fittings in addition to the basic 3", 4" and 5" boxes, built according to Navy drawings, are now in production, and prompt delivery can be assured. New numbers, not listed here are being added to the line, and information on these will soon be available.

9-S DEVICES AND SWITCHES

9-S Number	Type
4260-L	ES(W.T.)
4262-L	FS(N.W.T.)
4477-L	VIII(W.T.)
4264-L	FS(W.T.)
4563-L	M-N(N.W.T.)
4718-L	CCS(W.T.)
4718-L	DDS(N.W.T.)
4719-L	FFS(W.T.)
4719-L	GGS(N.W.T.)
4720-L	TTS(W.T.)
4721-L	MMS(W.T.)
4816-L	FFF(W.T.)
4816-L	FFF-1(W.T.)
4873-L	GG(W.T.)
4914-L	M-IS(W.T.)
4234-L	G-S(W.T.)
4496-L	C-S(W.T.)
4777-L	V-IS(W.T.)
4923-L	IK-S(W.T.)
5174-L	V-S(W.T.)

9-S FIXTURES

9-S Number	Type
4535-L	J-S(White,W.T.)
4535-L	JR-S(Red,W.T.)
4535-L	JG-S(White,W.T.)
4535-L	JRG-S(Red,W.T.)
4536-L	J-S(White,W.T.)
4536-L	JR-S(Red,W.T.)
4537-L	L-S(White,W.T.)
4537-L	LR-S(Red,W.T.)
4537-L	LGS-S(White,W.T.)
4537-L	LRGS(Red,W.T.)
5121-L	III-ES(White,W.T.)
5121-L	III-ESR(Red,W.T.)
5122-L	IV-ES(White,W.T.)
5163-L	LL-S(White,N.W.T.)
5163-L	LLR-S(Red,N.W.T.)
5163-L	LLGS(White,N.W.T.)
5163-L	LLRGS-S(Red,N.W.T.)
5173-L	JS-S(White,W.T.)
5173-L	JRS-S(Red,W.T.)
5173-L	JGS(White,W.T.)
5173-L	JRGS(Red,W.T.)
5186-L	LS-S(White,W.T.)
5186-L	LRS-S(Red,W.T.)
5186-L	LGS-S(White,W.T.)
5186-L	LRGS-S(Red,W.T.)

N. Y. OFFICE: 33 West 42nd St., N. Y. C.

THE SPERO ELECTRIC CORPORATION
18222 LANKEN AVE. ★ CLEVELAND, OHIO

Good Lighting Reduces Accidents and Rejects

(Continued from page 15)

tions were made at the Capitol Steel and Iron Company about a year and a half ago in the drafting room on the second floor of the office building. Old installations there consisted of 150-watt, 12-in., direct lighting glassware set on about 13-ft. centers. Draftsmen often complained of eye strain and even headaches, work was slowed down, and errors were too frequent.

The company management consulted Oklahoma Gas & Electric Co. lighting engineers and was sold on the idea of putting in a more modern system. The steel firm had its own electrician, and he was authorized to install the new lighting according to plans furnished by the utility company engineers. These installations include 8 Guth Excelux

shielded, fluorescent units placed on 13-ft. centers and about 11 feet above the floor. Each unit contains four, 40-watt white fluorescent lamps.

Drafting room employees and the management noticed such marked improvement here, that later, 18 more units of the same type were installed in the general offices downstairs. An employee of the drafting room said that working conditions in that department had been improved immeasurably by the new lighting system. The old yellowish light has been replaced, he said, by a clear, soft white light evenly diffused over the working surfaces in such a way as not only to relieve eye strain but to bring out the most delicate tracings.

Highly beneficial results in the drafting rooms and other offices led to the installations in the shops. A different lighting system was decided upon to meet the particular needs there, as heretofore described.

"The improved lighting in the offices and shops has many times paid for the cost of installations and maintenance" said Mr. Kramer, when asked about the monetary angle. "But the major consideration of maximum output with a minimum of waste of materials and labor, accompanied by a marked reduction in accidents, has been accomplished, largely due to more modern lighting," Mr. Kramer concluded.

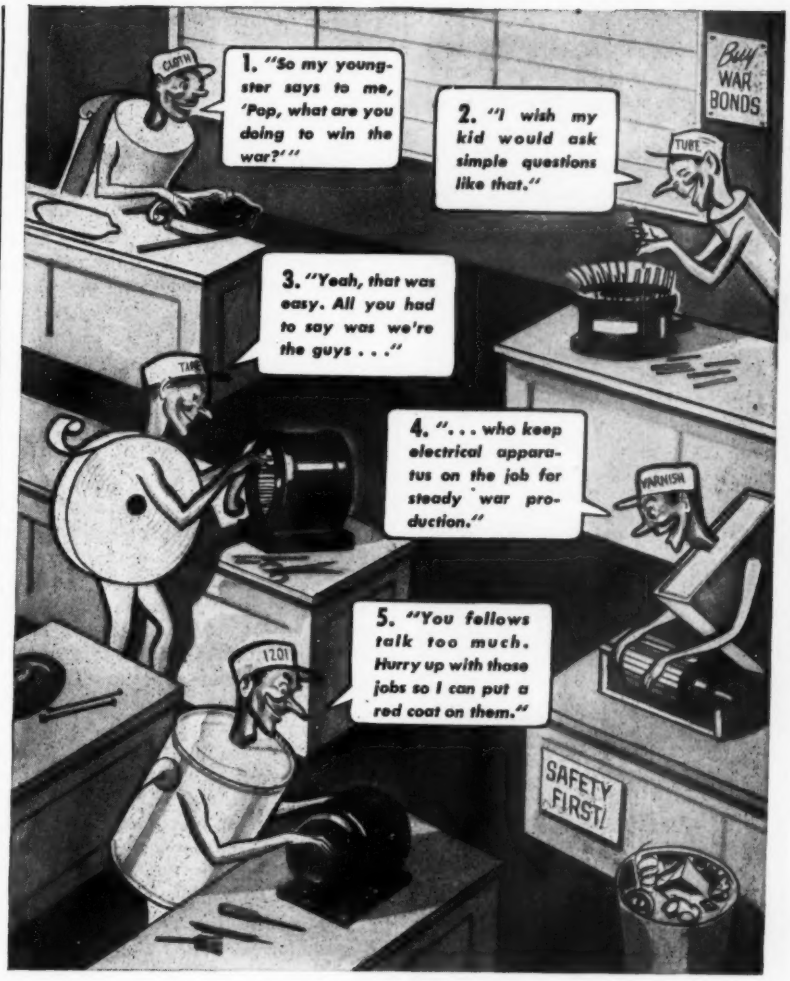
Appliance Limitation Order Is Revised

(Continued from page 31)

amended order also tightens control over production of repair parts through restrictions, limitations, and a trade-in-or-scrap plan.

Since May 31, 1942, and until this new order, production of all electric appliances had been cut off completely except for certain types to fill military and similar preferred orders. The revised order opens no new production for general civilian use. Its principal general effect is in banning the production of repair parts for luxury electric appliances.

Flat irons, air heaters, and water heaters have been added to the electric appliances that may be produced for preferred orders (Army, Navy, Maritime Commission, and War Shipping Administration). Previously, the permitted list for preferred orders included only:


1. "So my youngster says to me, 'Pop, what are you doing to win the war?'"
2. "I wish my kid would ask simple questions like that."
3. "Yeah, that was easy. All you had to say was we're the guys . . ."
4. ". . . who keep electrical apparatus on the job for steady war production."
5. "You fellows talk too much. Hurry up with those jobs so I can put a red coat on them."
Buy WAR BONDS
SAFETY FIRST

PROTECTING ELECTRICAL APPARATUS FOR LONGER LIFE

There's a G-E Insulation for Every Need

These are only 5 of a complete line of insulation materials designed for service under all conditions. For detailed information, write to Section M732-16, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn.

GENERAL ELECTRIC

broilers, food choppers, food mixers, food grinders, food servers, food slicers, fry kettles, griddles, hotplates, juicers, ovens, ranges, toasters, urns, and vegetable peelers.

Production of the latter group may be resumed by a manufacturer for civilian use, but only of the commercial and heavy duty types, and not in excess of 10 per cent per quarter of the number of these units he had produced during 1940. Furthermore, he must not accumulate in his inventory more than 15 per cent of his 1940 production of each item.

This supply is intended to relieve shortages of food-preparation equipment needed in hospitals, war industry cafeterias, and at civilian-operated training schools which serve military personnel.

Specific authorization must be obtained from WPB for transfer of new commerce and heavy duty electric appliances. All permitted electric appliances for military orders, however, may be transferred automatically.

In production of all new electric appliances, manufacturers are limited in the use of copper to the minimum amounts needed for conducting electricity or for the proper functioning of parts.

Use of copper is the limiting and restricting factor of repair parts production. Use of this critical metal is specifically restricted to certain parts of certain types of appliances. Generally, the restrictions narrow such use to current-conducting parts in appliances that are important in household routine, such as roasters and flat irons.

Replacement cord sets are prohibited except for electric flat irons. Such cords must conform to specifications stated in the order, including a maximum length of 6 feet. Until the end of this year a manufacturer may produce up to 25 per cent of his total 1940 production of flat iron cords. Beginning January 1, he may produce the 25 per cent during each six-month period.

A manufacturer's production and inventory of all other replacement and repair parts may at no time exceed his total sales of the same repair parts during the previous six months.

Manufacturers and distributors are not permitted to transfer a repair or replacement part unless a similar used part is given in exchange; or unless they are assured that the similar used part is being held for them, to be forwarded later or turned in for scrap, whichever they themselves request. Preferred orders are exempt from this provision.

Service Work Pushed By Contracting Firm

(*Continued from page 25*)

owners of electrical equipment are paying more attention than ever to its proper upkeep and, of course, we encourage them in that. They all realize that replacements are hard if not impossible to obtain."

The Dyer shop advertises that it "rewires or rewinds anything" and its modern equipment includes a baking vault and a large baking oven. Earle M. Minyard, the shop foreman, has handled some tough jobs over his 25 years experience as a motor expert. Just recently a 200 hp, a-c generator for a clay products company went bad and Minyard was called on the job. Finally with the use of the sparks from two dry-cell batteries he determined the trouble. One of the inside fields (there were 8 in all) had a defective contact, due apparently to improper soldering at the factory. He soon made the repair and had the factory back in operation. He stated that his shop carried a number of spare motors and parts, so that usually it can keep a plant running while a vital motor or part is peing repaired.

Maintenance For Small Motors

(*Continued from page 14*)

being drawn by the motor will run free and has no damaged parts to cause binding or sticking of the mechanism. Also, be sure that the machine has been lubricated and adjusted in accordance with the manufacturer's specifications.

On many fractional-horsepower motors are installed thermotectors to protect the motors from overheating. If the motor stops for other than normal reasons, it may be due to the operation of this thermotector.

Motors equipped with the device of the manual reset type can be restarted by pushing the red button on the end shield, after the motor cools. Motors equipped with the automatic type device start automatically after cooling. If the motor fails to start after it cools

check the source of power.

While most conventional fractional-horsepower motors are made with cast aluminum, non-destructible rotors, many of them are fitted with commutators and brushes. In these motors the proper operation of the brushes is essential in order to obtain satisfactory motor performance. Improper seating of the brushes on the commutator will cause loss of power output and in many cases excessive sparking at the brushes. Excessive sparking will result in radio interference and pitting of the commutator surface.

Since all brushes are properly seated when the motor leaves the factory, all that is necessary for proper maintenance is to inspect the brushes periodically to make certain they are not worn out. When replacing the brushes be certain that they are reinstalled in exactly the same position as they were originally.

Industrial Network Distribution Systems

(Continued from page 11)

personnel, that may accompany the burning clear of the fault cannot be risked even in 208Y/120-volt circuits. Therefore, circuit protective devices which will quickly open a faulty circuit are required in all secondary circuits.

It is generally considered far more dangerous to work on energized 480-volt circuits than on energized 208Y/120-volt circuits. Hence the advisability of working energized circuits in industrial plants is questionable and has generally been conceded as highly unsafe and undesirable. Because of the infrequent necessity for doing such work in those industrial plants where 208Y/120-volts may be used, it is questionable whether maintenance crews could be kept properly trained so that they could work energized circuits without taking undue risks. Therefore, switching means are required in all circuits of industrial electrical systems so that the cables may be deenergized for repair or maintenance.

Circuit switching and protection of cable circuits could be provided by adopting the limiter or fuse as used by the utilities (except designed for 480 volts) in combination with load-break switches. This combination, however, has one serious deficiency in that the switch element

WAR-PLANT LIGHTING WITH METAL-SAVING CURTIS UNITS

Effective illumination for the majority of war plant lighting and relighting projects can best be provided by utilizing industrial type fluorescent fixtures or silvered glass reflector units for large wattage incandescent or mercury lamps.

Curtis Lighting now carries both of these types in stock and is in a position to provide the quick delivery necessary to secure jobs.

CURTIS LIGHTING, INC.
6135 W. 65th STREET — CHICAGO, ILLINOIS

3 TIMES FASTER *with* **GREENLEE BENDERS**

If you are doing bending work now with obsolete or makeshift equipment, you'll find Greenlee Hydraulic Benders are 3 times faster. One man can operate . . . smooth, accurate bends are made in a jiffy. There's no wrestling of heavy conduit or equipment . . . all Greenlee Benders are light, portable, and compactly built. Model No. 770, shown at left, has 25-ton capacity — bends 1¼" to 3" pipe or conduit. A 40-ton unit handles 3" to 4½" material. Send for Catalog 33-E.

NO. 770 RIGID CONDUIT AND PIPE BENDER

STEEL TUBE BENDER

Whatever you have to bend — tubing, conduit, pipe, or bus bar — there's a Greenlee Bender to do the job in a jiffy. Shown above is the No. 763 Greenlee steel tube bender for bending ¼" to ¾" steel, copper, brass and aluminum tubing. For full details, write for Booklet S-116.

KNOCKOUT - TOOLS

Greenlee knock-out punches and cutters are fast operating, too . . . are old "stand-bys" for the electrician. They enlarge holes in conduit boxes and cabinets without drilling, reaming, and filing. They are made from high-grade steel, and are properly heat-treated to stand the strain and stress of hard usage. They are, today, saving hundreds of contractors vital hours on war jobs. Write for Catalog 33-E.

Greenlee TOOL CO.
1767 Columbia Ave., Rockford, Illinois

SAVE TIME—select your conductor fittings from this Catalog . . **ALL** good types

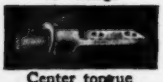
You can buy Tee Connectors, Grounding Clamps, Cable Taps . . . Straight, Parallel, Elbow and Cross Connectors . . . Service Connectors, Bus Supports, Terminals . . . *practically every good type, in the COMPLETE line.*

JUST FOR EXAMPLE— here are some of the standard Penn-Union Vitite terminal lugs:

2-bolt flange

45° flange

Side flange


Center tongue

Round, 45°

Round, 90°

Round, offset

Round, center

These types and many more—in a complete range of sizes. Write for Catalog.

Penn-Union connectors are the first choice of leading utilities, industrials, electrical manufacturers and contractors. They have found that *"Penn-Union" on a fitting is their best guarantee of Dependability.*

L. MORRIS LANDERS
309 Walton Building ATLANTA, GA.
WALTER J. HUEMMER
Dallas Transfer & Terminal Warehouse Bldg. DALLAS, TEXAS
PENN-UNION ELECTRIC CORPORATION
ERIE, PA.

PENN-UNION
Conductor Fittings

may fail, endangering nearby personnel and surrounding equipment, when the switch is operated at currents beyond its rating, such as closing in on a fault[6]. For that reason and because they generally cost no more, air circuit breakers are used for circuit switching in industrial networks.

In most industrial plants, the maintenance departments are occupied mainly with keeping production machinery going and therefore do not want to keep a staff of technically trained personnel who are acquainted with the operation and maintenance of network protectors and their associated relays. Neither do they generally want to make the investment in laboratory and testing facilities required for the proper testing of such equipment. In several cases where industrial plants have network systems, the local utility is called in for maintenance of the protectors and relays.

From the operation and maintenance viewpoints, the network system appears more favorable to the utility than to the average industrial.

Load Shifts

On utility systems the loads are continually shifting and generally increasing. The secondary network system is particularly suited to such conditions for the secondary ties tend to distribute the load evenly over all transformers. Hence the transformers in the lightly loaded areas assist the transformers in the heavily loaded areas. Since the lightly and heavily loaded areas shift from time to time, this means that the transformers need not have capacity to care for the heaviest load that may occur in its area. This reduces the transformer investment.

It is not to be inferred from this that loads can be added at random without system planning. On the contrary, checks should be made to see what the effect of load additions will be on cables and transformers adjacent to the new load. Such checks are best made on a calculating board.

In many types of industrial plants, loads are continually shifting and new ones frequently added. Hence the secondary network would reduce the transformer investment in industrial plants the same as in the utility systems. It has already been pointed out that when transformers are paralleled, short circuit currents are increased, which increases the size and cost of the secondary switchgear used in industrial plant networks. Hence, one must weigh the saving in transformer cost effected by the network in an industrial plant against the increased cost of switchgear. Furthermore, the network requires additional investment in the secondary tie cable circuits. The switchgear factor is absent in the utilities.

In industrial plants load shifts can be cared for by using excess transformer capacity in radial distribution systems or by the secondary network distribution system. The latter requires secondary tie circuits and more expensive switchgear than does the radial systems.

Modified Radial System

Modified radial systems of the primary selective and secondary selective types[7] will improve the service reliability of the simplest radial systems. The basic factors affecting the application of modified radial systems are discussed here.

Because the utilities have no manpower available to perform numerous switching operations over a

Laboring under terrific strain, engineers are striving to improve electrical units so that they will perform more efficiently and meet diversified needs.

As units must comply with specifications and pass rigid inspections, why not follow through by specifying DOLPH'S Insulating Varnishes? After all, your electrical units are no better than the varnish which protects them.

The DOLPH Laboratories are developing new varnishes to meet the needs of improved electrical units. The answer to your insulating problem may be found in the DOLPH Laboratories. There are no obligations, so why not inquire?

Dolphs

JOHN C. DOLPH COMPANY

Insulating Varnish Specialists

166 Emmet Street, Newark, New Jersey

YOU CAN DEPEND ON

Sepco

1915 - 1943

ELECTRIC WATER HEATERS

ALTHOUGH WAR TIME CONSTRUCTED THEY STILL GIVE THEIR USUAL EFFICIENT, . ECONOMICAL PERFORMANCE WITH THEIR LONG LIFE LOW WATTS DENSITY HEATING UNIT, THEIR POSITIVE SNAP ACTION THERMOSTAT AND MOST EFFICIENT HEAT INSULATION MANUFACTURED AND GUARANTEED BY

AUTOMATIC ELECTRIC HEATER CO.

POTTSTOWN, PENNA.

TEST INSULATION THE MODERN, EASY WAY WITH A

MODEL B-5 MEGOHMER

No more tiresome cranking of a hand-driven generator . . .

OUR NEW BATTERY-VIBRATOR TYPE INSULATION TESTERS OPERATE AT A

STEADY TEST POTENTIAL OF 500 VOLTS DC

available at the touch of a switch. Portable, entirely self-contained, direct reading in megohms for insulation resistance and ohms for low resistance testing. Various new models and ranges. Write for bulletin No. 430.

HERMAN H. STICHT COMPANY, INC.

27 PARK PLACE NEW YORK, N. Y.

One "Quickie" Salvage Job Isn't Enough . . .

You've Just Begun to Scrap

"Once-over lightly" doesn't even *begin* to turn up the full scrap potential of the average shop. Tremendous quantities have been either neglected or overlooked.

It's amazing what the second and third time around will yield when everybody is convinced that you mean business. Out they come—hidden tons of ancient parts and fittings, useless dies and jigs, everything from cotter pins to drill presses!

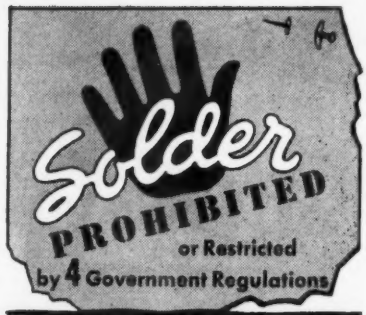
Use It—Sell It—or Scrap It!

Maybe you can't use some good machinery—yet it hasn't reached the scrap stage. Okay—sell it. Usually somebody else is looking for that equipment. You'll get prices far better than those for scrap. And you'll do your Uncle Sam a good turn into the bargain.

C. B. ROGERS

ELECTRICAL HEATING ENGINEER
CHROMALOX
ELECTRICAL HEATING UNITS
and
CHROMALOX
EQUIPPED PRODUCTS

1000 PEACHTREE STREET
ATLANTA, GEORGIA



. . . And here's the IDEAL Solution to the Problem!

IDEAL Wire-Nuts

Meet ALL Government Requirements

An ALTERNATE AND IMPROVEMENT for Solder and Tape.

IDEAL "Wire-Nuts" (Solderless, Tapeless, Wire Connectors) contain no copper or copper alloys—no tin, or rubber as used with solder-and-tape joints. Every time you use "Wire-Nuts" you conserve vital materials needed for the War Program. Easy to use; strip wires, screw on, that's all! Make a neater, safer joint: better electrically; stronger mechanically. Fully Approved. Listed by Underwriters' Laboratories, Inc. Sizes for connecting all combinations from two No. 18 to three No. 10, solid or stranded wires. IMMEDIATELY AVAILABLE.

IDEAL Sold through Jobbers

Prompt Delivery

IDEAL Sycamore

• IDEAL COMMUTATOR DRESSER CO •

1017 Park Avenue Sycamore, Illinois

A Steel Wire is no better than its Core

STRAIGHT CONNECTOR

for Aluminum Cable

BOLT-PRESSURE TYPE

Capacity: No. 4 to 4/0—With Solid Core Wire Only

FULL CONDUCTIVITY AFTER JOINING CABLE . . . GRIP EQUAL TO TENSILE STRENGTH OF CABLE

Designed to join cable, comprised of one hard steel wire surrounded by aluminum strands. A joint thus made will withstand a tensile strain equal to the rated tensile strength of the cable itself, without injury to the cable, and without (by test) causing a noticeable millivolt drop.

WRITE FOR BULLETIN 14-A

K&H KRUEGER & HUDEPOHL

Solderless Terminal Lugs and Connectors

VINE AT THIRD-ES • CINCINNATI, OHIO

wide area within a short period of time, such as would be required in the event of cable failure supplying a radial system in the downtown area of a large city, throwover schemes must be automatic for use in such areas. The outage time accompanying manual transfer cannot be tolerated even if sufficient personnel were available to make manual transfer practical.

Any automatic throwover arrangement costs as much or more than a network protector and, since there is no secondary switching involved, there is no saving that can be made in the radial system because of this system's lower short circuit currents. Throwover arrangements, therefore, have not proven popular in utility underground systems for commercial areas.

In the average industrial plant the distances are short and the necessity for performing switching operations is very infrequent. Hence, the normal maintenance personnel can usually handle adequately any circuit switching required as a result of an outage of any one feeder in a modified radial system equipped for manual transfer.

In many plants a feeder or transformer outage in the simplest radial systems would cause prolonged outages which cannot be tolerated. Modified radial systems enable these outages to be cut to a few minutes by transferring the load to healthy circuits.

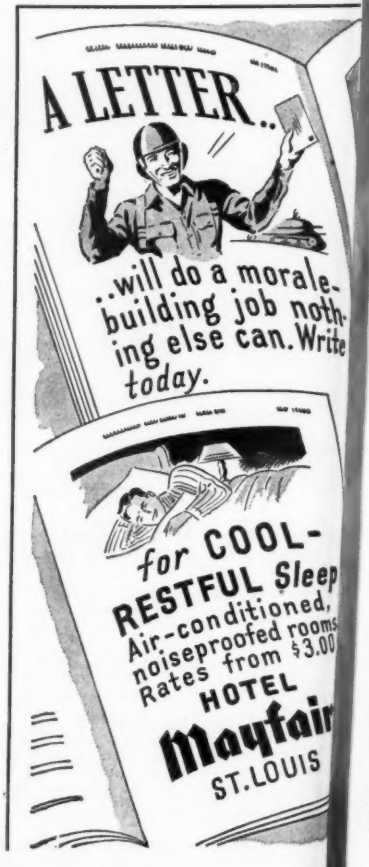
In modified as in the simplest radial systems, transformers are not operated in parallel; hence short circuit currents are lower than in the network. As pointed out previously, this enables much lower cost secondary switching equipment in radial systems.

The service reliability of the modified radial systems is adequate for most industrial manufacturing plants, except those where the few minutes' outage required for manual transfer would cause spoilage of the product in process or where work over an area much larger than served by the faculty circuit would be stopped. Its reliability and its lower cost have made the modified radial system very popular in plants recently built for the war program.

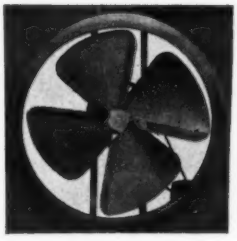
The secondary network system will undoubtedly be used in many industrial plants in the future. However, when considering the secondary network, the plant engineer should study its cost and characteristics in the light of industrial requirements rather than accept it on the basis of the utility's experience, because of the difference in service reliability, requirements, economics, maintenance and operation.

Bibliography

1. "Underground A-C Network Distribution for Central Station Systems"—By A. H. Kehoe, A.I.E.E. Transactions, June, 1924, Vol. 43, Page 844.
   Distribution Systems Debated — Electrical World, July 4, 1925. Page 15.
   "Low-voltage A-C Networks" — By D. K. Blake. General Electric Review. February through November, 1928.
2. "Can 24-Karat Service Always Be Justified?"—By H. R. Woodrow. Electrical World, June 15, 1940. Vol. 113. Page 1892.
3. "A-C Network Operation"—1936-1937 Edison Electric Institute Transmission and Distribution Committee Meeting Minutes, Oct. 11, 1938.
4. "Network Short Circuits Not Always Self Clearing" — By W. R. Bullard. Electrical World, Oct. 17, 1929. Page 779.
   "Low-voltage A-C Networks of the Standard Gas & Electric Co's. Properties" — By Stanley and Sinclair A.I.E.E. Transactions Jan. 1930. Vol. 49. Page 265.
   "Burn-off Characteristics of A-C Low-voltage Network Cables"—By G. Sutherland and D. C. MacCorkle. A.I.E.E. Transactions, Sept. 1931. Vol. 50. Page 831.
5. "Short Circuit Protection of Distribution Networks By the Use of Limiters"—By C. P. Xenis, Electrical Engineering, Sept. 1937, Page 1191.
6. "Fundamental Considerations in Selecting Metal-enclosed Switches for Unit Substations and Secondary-network Transformers"—By W. J. McLachlan and D. L. Beeman. General Electric Review, May 1942. Vol. 45. Page 293.
7. "The Fundamentals of Industrial Distribution Systems"—By D. L. Beeman and R. H. Kaufmann. A.I.E.E. Transactions, 1942. Vol. 61.



THE "Fresh-Air MAKER"



provides fully the comfort and ventilation so essential in army barracks, mess halls, hospitals, headquarters, theaters and other military buildings. Its fine design and sound construction meet the specifications drawn for army fans and it is particularly adaptable to the various types of installations found in army buildings.

HY-DUTY BLOWERS

Single Inlet—Double Inlet. 400 CFM to 12,500 CFM.

Single Inlet Blower illustrated at left is particularly adapted for ventilation of mess halls in military establishments.

BLOWER DIVISION
SCHWITZER-CUMMINS COMPANY
1145 EAST 22ND STREET INDIANAPOLIS, U. S. A.

When "KNOW-HOW" is important

let MILLER do it!

The South's largest general electrical contractor offers you the experience gained from millions of dollars worth of successfully completed contracts for Army, Navy and civilian projects of all kinds including structural work and public utilities distribution systems.

Full equipment and engineering staff available to service any contract, regardless of size.

Miller Electric Company

556 Riverside Ave. Jacksonville, Florida

CAN'T GET 'EM UP *in the morning!*

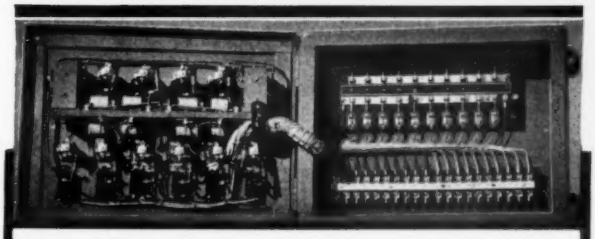
It's those luxuriously comfortable beds at all
DEWITT OPERATED HOTELS

In Cleveland HOTEL HOLLENDEN
In Columbus NEIL HOUSE
In Lancaster, O. THE LANCASTER
In Corning, N. Y. THE BARON STEUBEN

Check IN

THEO. DEWITT PRESIDENT

DeWITT OPERATED HOTELS



Marine Electrical Specialties

All types of electrical specialties, boxes, cabinets, control panels, duct-work, etc., manufactured by an organization accustomed to meeting exacting Army and Navy specifications. Full engineering personnel and equipment for manufacture of special electrical items in addition to all standard articles.

Write for information.

Jacksonville Metal Manufacturing Company
JACKSONVILLE, FLORIDA

TAYLOR FIBRE

TO MEET EVERY EXACTING JOB
TO KEEP YOUR CUSTOMERS SATISFIED

Specify **"TAYLOR"** *when you need*

Vulcanized Fibre Sheets
Vulcanized Fibre Rods
Vulcanized Fibre Tubing
Fibre Washers
Phenol Fibre Rods
Phenol Fibre Sheets
Phenol Fibre Tubing

For complete details see pages 8, 9, and 10 of the IWI BLUE CATALOG. If you do not have it, write today.

INSULATION AND WIRES
IWI
SERVICE

Distributed By

INSULATION and WIRES, Incorporated
2127 Pine Street, St. Louis, Missouri
289 Simpson Street, N. W., Atlanta, Georgia

ADVERTISER'S INDEX

The Advertisers' Index is published as a convenience, and not as a part of the advertising contract. Every care will be taken to index correctly. No allowance will be made for errors or failure to insert.

A
Adam Electric Co., Frank 8
Aluminum Co. of America ..... *
American Blower Corporation 2
American Coolair Corp. 49
American Steel & Wire Co. ..... *
Anaconda Wire & Cable Co., Inc. 6
Automatic Electric Heater Co., Inc. 57

B
Biddle Co., James G. 44
Briegel Method Tool Co. 56
Bright Light Reflector Co., Inc. 47
Bryant Electric Co. ..... *
Bull Dog Electric Products Co. 43
Burndy Engineering Co., Inc. 46

C
Crescent Insulated Wire & Cable Co. 41
Curtis Lighting, Inc. 55

D
Dolph Co., John C. 57

E
Edison General Electric Appliance Co. ..... *

F
Federal Electric Products Co., Inc. ..... *
Frigidaire Division 45

G
General Cable Corp. ..... *
General Electric Co. (Appliances) ..... *
General Electric Co. (Insulating) 53
General Electric Co. (Lamps) ..... 4 and 5
General Electric Co. (Wiring Materials) ..... Back Cover
Graybar Electric Co. ..... *
Greenlee Tool Company 55

H
Hazard Insulated Wire Works 1
Hotel Hollenden 59
Hotel Lennox 56
Hotel Mayfair 58
Hubbard & Company 59
Hunter Fan & Ventilating Co., Inc. ..... Front Cover

I
Ideal Commutator Dresser Co. 53
Insulation & Wires, Inc. 60

J
Jacksonville Metal Mfg. Co. 59
Johns - Manville ..... *

K
Krueger & Hudepohl 58

L
Lloyd Products Co. 60

M
Miller Electric Co. 59
Mitchell Mfg. Co. 29

N
National Electric Products Corp. 54

O
Okonite Company 1

P
Penn-Union Electric Corp. 58

R
Robbins & Myers, Inc. ..... *
Rogers, C. B. 60

S
Sangamo Electric Co. ..... *
Schwitzer-Cummins Co. 48
Spero Electric Co. 52
Square D Company ..... Inside Back Cover
Sticht Co., Inc., Herman A. 51
Subox, Inc. ..... *
Superior Electrical Industries 51
Sylvania Electric Products, Inc. ..... Inside Front Cover

U
United States Rubber Co. (Tape Division) ..... *
United States Rubber Co. (Wire Division) ..... 38 and *
United States Steel Co. ..... *
Uptegraff Mfg. Co., R. E. ..... *

W
Ward Leonard Electric Co. ..... *
Westinghouse Electric & Mfg Co. (Appliances) ..... *
Westinghouse Electric & Mfg. Co. (Lamps) ..... *
Westinghouse Electric & Mfg. Co. (Motor Controls) ..... *
Wiegand Co., Edwin L. ..... *
Wiremold Company ..... *

Y
Youngstown Sheet & Tube Co. ..... *

EX

not as a
to index
insert.

6
*
2
40
*
6
57

44
50
47
*
43
46

41
56

57

*
*
45

*
*
53
4 and 5
Back Cover
*
55

1
50
56
53
35
Front Cover

53
60

59
*

56

60

59
29

54

1

56

*
51

*
53
Back Cover
51
*
51
Front Cover

*
38 and

ULY, 19